Fishery Data Series No. 97-40

Age Composition and Spawning Escapement of Chinook Salmon in the Karluk, Ayakulik, and Chignik Rivers, Alaska, 1995 and 1996

by

Tim Motis

December 1997

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

FISHERY DATA SERIES NO. 97-40

AGE COMPOSITION AND SPAWNING ESCAPEMENT OF CHINOOK SALMON IN THE KARLUK, AYAKULIK, AND CHIGNIK RIVERS, ALASKA, 1995 AND 1996

by
Tim Motis
Division of Sport Fish, Kodiak

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

December 1997

This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-11, Job No. S-2-10a and Project F-10-12, Job No. S-2-10a.

The Fishery Data Series was established in 1987 for the publication of technically-oriented results for a single project or group of closely related projects. Fishery Data Series reports are intended for fishery and other technical professionals. Distribution is to state and local publication distribution centers, libraries and individuals and, on request, to other libraries, agencies, and individuals. This publication has undergone editorial and peer review.

Tim Motis
Alaska Department of Fish and Game, Division of Sport Fish
211 Mission Road, Kodiak, Alaska 99615-6399, USA

This document should be cited as:
Motis, T. 1997. Age composition and spawning escapement of chinook salmon in the Karluk, Ayakulik, and Chignik rivers, Alaska, 1995 and 1996. Fishery Data Series No. 97-40, Anchorage.

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

In June 1993, the Alaska Department of Fish and Game, Sport Fish Division, initiated a project to monitor the status of the chinook salmon *Oncorhynchus tshawytscha* stocks of the Karluk, Ayakulik and Chignik rivers, the largest and most utilized stocks in the Kodiak Management Area. This report presents data collected in 1995 and 1996. We censused inriver returns of chinook salmon to the three rivers by counting fish passing weirs on the rivers. Age and sex compositions of the Karluk and Ayakulik inriver returns were estimated by sampling chinook salmon at the weirs. Age and sex composition of the Chignik inriver return was estimated by sampling the commercial harvest in Chignik Lagoon. Sport fishing effort, and catch and harvest of chinook salmon for the Karluk and Ayakulik rivers were estimated through the Statewide Harvest Survey. Sport harvests from the Karluk and Ayakulik rivers were sampled to estimate sex composition of the harvests. Spawning escapements to the Karluk and Ayakulik rivers were estimated by subtracting sport harvest from inriver return because most harvest at these rivers occurs above the weirs. Estimates of sport harvest are not available for the Chignik River because of insufficient returns of questionnaires to the Statewide Harvest Survey.

In 1995, the inriver return to the Karluk River was 12,657 chinook salmon. Ages 1.4 and 1.3 comprised 72% of the inriver return; the male/female sex ratio was 1.5:1.0. An estimated 1,284 chinook salmon were harvested (586 males and 698 females) and 2,613 were released in the sport fishery; sport fishing effort for the entire year and all species was an estimated 6,928 angler-days. Spawning escapement was 11,373 chinook salmon.

The 1996 inriver return to the Karluk River was 10,051 chinook salmon. Ages 1.4 and 1.3 comprised 64% of the inriver return; the male/female sex ratio was 1.7:1.0. An estimated 769 chinook salmon were harvested out of a total catch of 2,382 chinook salmon. Sport fishing effort was 6,237 angler-days. Spawning escapement was 9,282 chinook salmon.

In 1995, the inriver return to the Ayakulik River was 17,701 chinook salmon, mostly age 1.4 (60%). The male/female sex ratio was 1.7:1.0. Sport anglers harvested an estimated 200 chinook salmon (104 males and 96 females), releasing 883, and expending 1,299 angler-days over the entire year and all species. Spawning escapement was 17,501 chinook salmon.

The 1996 inriver return to the Ayakulik River was 10,344 chinook salmon, predominantly ages 1.4 (39%), 1.3 (24%), and 1.2 (25%). The male/female sex ratio was 1.7:1.0. Anglers harvested 203 chinook salmon out of a total catch of 794 fish. Sport fishing effort was 2,038 angler-days. Spawning escapement was 10,141 chinook salmon.

In 1995, 3,219 chinook salmon were harvested in the commercial purse seine fishery in Chignik Lagoon; 1,579 chinook salmon in 1996. The inriver return to the Chignik River was 4,288 chinook salmon in 1995, and 3,485 chinook salmon in 1996. In 1995, most chinook salmon were ages 1.2, 1.3, and 1.4; in 1996, ages 1.3, 1.4 and 1.5. The male/female sex ratio was 1.0:1.0 in 1995, and 0.7:1.0 in 1996.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, escapement, Karluk River, Ayakulik River, Chignik Lagoon, Chignik River, age, length, sex compositions, sport harvest and release, sport effort.

INTRODUCTION

The largest chinook salmon *Oncorhynchus tshawytscha* populations in the Kodiak Management Area (the Kodiak Island Archipelago, Alaska Peninsula waters west of Cape Douglas on the Pacific side and Cape Menshikof on the Bering side, and the Aleutian Islands) are from the Karluk, Ayakulik (Red), and Chignik rivers. All three populations are harvested incidentally by commercial fisheries targeting sockeye salmon *O. nerka* and also support sport fisheries. Chinook salmon in the Karluk and Chignik rivers are also harvested in a subsistence fishery. Because these chinook salmon returns are harvested in commercial and sport fisheries, it is essential that escapement goals be established that will result in optimum returns and harvests. The purpose of this study is to enumerate, and estimate the age and sex composition of, the inriver returns; estimate the sex composition of the sport harvest; and estimate spawning escapement to these rivers. These data are needed to construct brood tables that will be used to

refine escapement goals and harvest guidelines for management of these chinook salmon fisheries.

THE KARLUK RIVER

The Karluk River, located on the southwest end of Kodiak Island (Figure 1), contains one of only two native populations of chinook salmon on Kodiak Island. From its source at the outlet of Karluk Lake, the Karluk River flows 35.2 km (22 mi) to its terminus at Karluk Lagoon. Virtually all the land surrounding the Karluk River is owned by native corporations. Chinook salmon of Karluk River origin are harvested in sport, commercial, and subsistence fisheries.

The primary commercial harvest of Karluk River chinook salmon occurs in a mixed-stock fishery along the west side of Kodiak Island (Appendix A1). Chinook salmon harvested in the commercial fishery include the Karluk River stock, as well as the Ayakulik River stock and other stocks of unknown origin. This fishery usually begins on 9 June. Because over 97% of the escapement to the Karluk River generally occurs by 15 July, this stock is considered to be commercially exploited from 9 June through 15 July. The Commercial Fisheries Management and Development Division (CFMD) of the Alaska Department of Fish and Game (ADF&G) documents commercial harvests of chinook salmon through fish ticket reports returned by fish processors.

The subsistence harvest of chinook salmon on the Karluk River is primarily conducted by residents of Karluk Village. Harvest in this fishery is documented by returned subsistence permits and household surveys. During complete village surveys conducted in 1987, 1989 and 1990, harvests ranged from 34 to 232 chinook salmon (Table 1).

The Karluk River sport fishery is spread out over the entire river and lagoon system. Anglers fishing the Karluk River typically gain access to the river in one of three fashions. Anglers fly into the village of Karluk via either float or wheel plane and fish Karluk Lagoon and the lower Karluk River. Others fly into Karluk Lake and float the Karluk River downstream either to the reach near the Portage where it is possible to land a float plane or all the way downstream to Karluk Lagoon. Finally, access may be gained by flying into the Portage reach via float plane. Anglers accessing the river in this manner either fish just this reach or float down to the Lagoon.

Sport fishing effort on the Karluk River doubled from the late 1980s to the early 1990s. Harvest of chinook salmon also has generally increased along with angling effort, but has been fairly stable since 1990 (Mills 1988-1994; Howe et al. 1995-1997) (Table 1, Figure 2). Sport harvest of chinook salmon and fishing effort on the Karluk River are estimated by the Statewide Harvest Survey (SWHS) (Mills 1988-1994; Howe et al. 1995-1997), although we conducted creel surveys at the Karluk River in 1993 and 1994 (Schwarz 1996). Estimates of fishing effort from the SWHS are for effort directed toward all species, not chinook salmon alone; however, the chinook salmon fishery is the major sport fishery on the Karluk River.

CFMD operates a weir on the Karluk River located about 400 m upriver of Karluk Lagoon. Over the past 10 years (1987-1996), counts of chinook salmon migrating through the weir ranged from 7,930 to 14,442 chinook salmon (Table 1, Figure 2, Appendix B1). Returns of chinook salmon to the Karluk River greatly increased starting in 1988. Weir counts averaged 11,852 chinook salmon from 1987 through 1996, compared to an average weir count of 4,019 chinook salmon

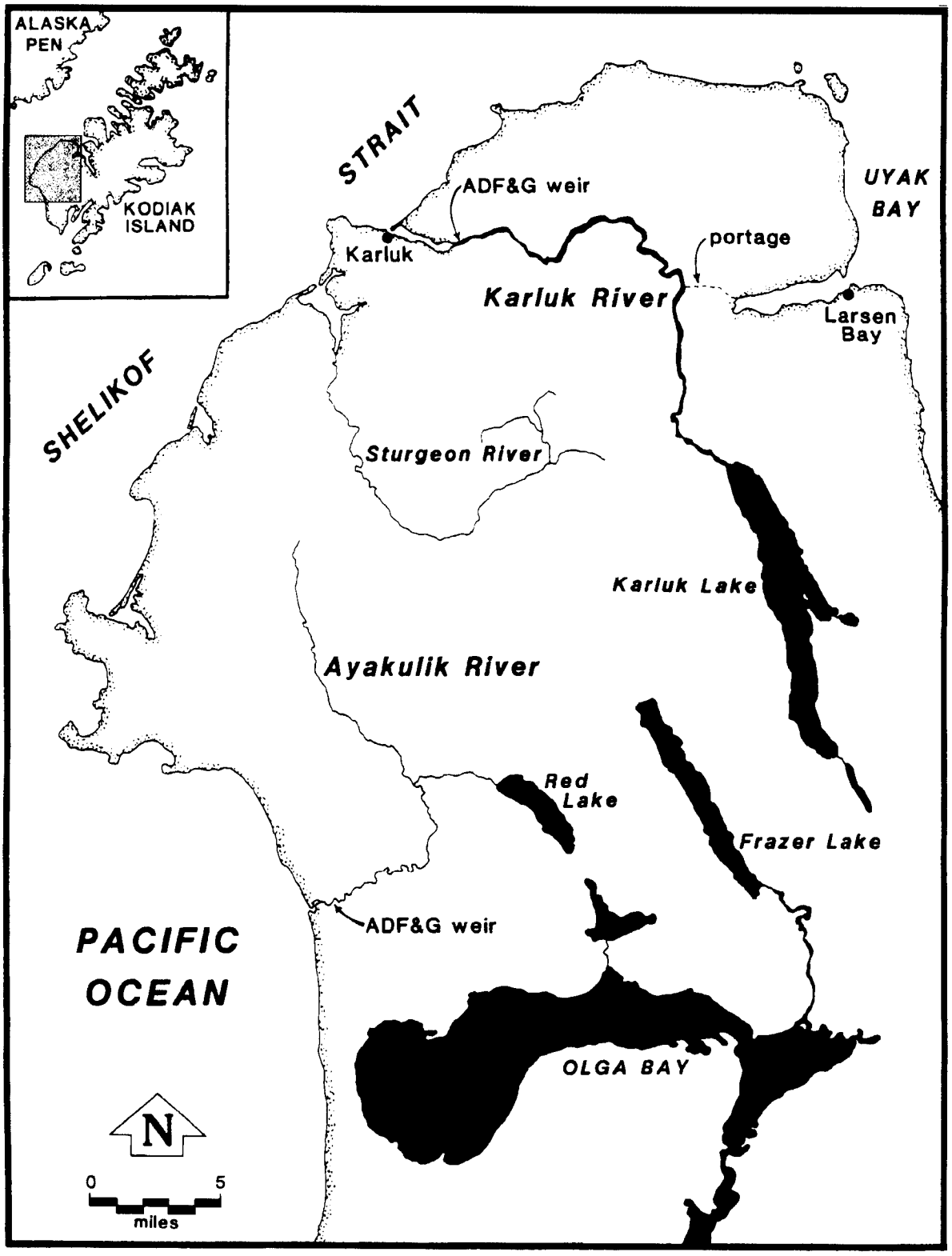


Figure 1.-Map of Karluk and Ayakulik rivers.

Table 1.-Total commercial harvest of chinook salmon from the west side of Kodiak Island, and subsistence and sport harvests from the Karluk River, along with inriver returns, 1987-1996.

Year	Total West Side Kodiak Commercial Harvest[a]	Karluk Village Subsistence Harvest[b]	Inriver Return[c]	Sport Fishery[d] Harvest	Release	Effort (angler-days)[e]
1987	1,554	97	7,930	199 [f]		3,459 [f]
1988	4,794		13,337	819		2,128
1989	0	34	10,484	559		2,420
1990	6,533	232	14,442	700 [g]	2,262	2,969
1991	6,060		14,022	1,599	3,119	4,547
1992	8,677		9,601	856	2,754	5,430
1993	11,675		13,944	1,634	6,735	6,894
1994	9,967		12,049	1,483	2,174	10,948
1995	7,023		12,657	1,284	2,613	6,928
1996	9,332		10,051	769	1,613	6,237
Mean	7,291 [h]	121	11,852	990	3,039	5,196

[a] Source: Commercial catch numbers extracted from ADF&G, CFMD Statewide Harvest Receipt (fish ticket) database. Includes all chinook harvested between Westpoint in Uganik Bay to Tannerhead in Alitak Bay through 15 July. See Appendix A1 for statistical areas. There was no commercial harvest in 1989 due to the *Exxon Valdez* oil spill.

[b] Estimated from household surveys.

[c] Brodie 1996. Census of chinook salmon passing Karluk River weir.

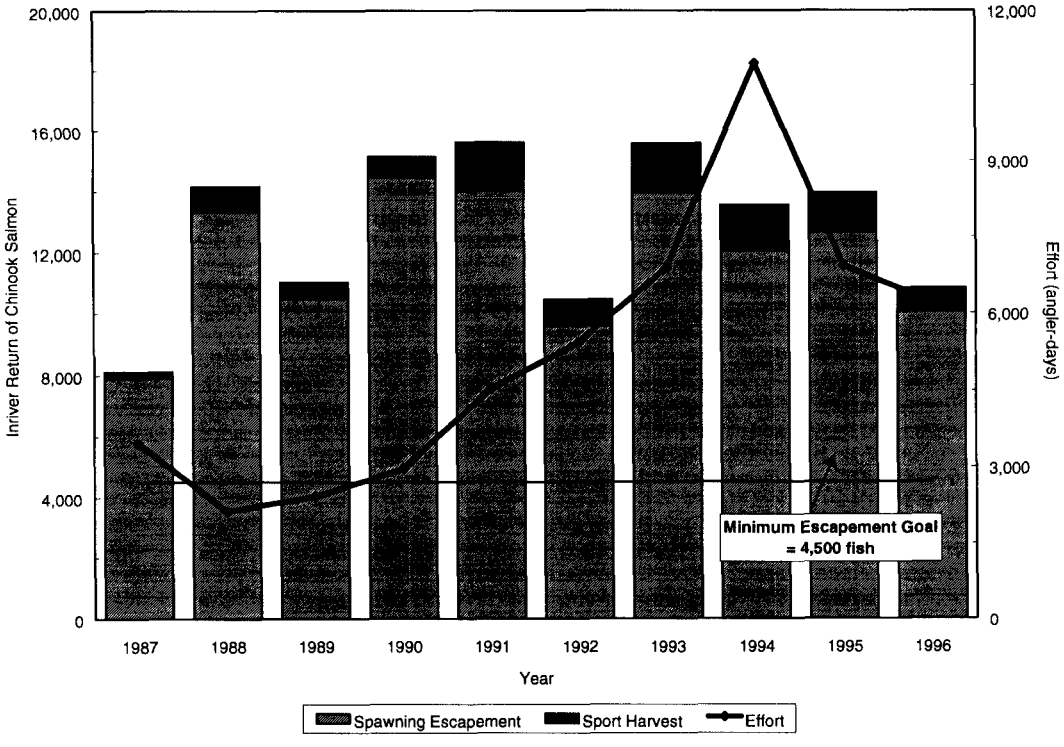
[d] Source Mills 1988-1994; Howe et al. 1995-1997.

[e] Includes effort directed toward all species, not chinook salmon alone.

[f] Estimates are based on fewer than 12 returned surveys and are, therefore, extremely imprecise.

[g] Includes 11 chinook salmon harvested from Karluk Lake that were not included in the original postal survey report (Mills 1991).

[h] This average does not include the zero catch in 1989 due to the *Exxon Valdez* oil spill.



Sources: Harvest and effort estimates from Mills 1988-1994, Howe et al. 1995-1997; inriver returns from Brodie 1996.

Figure 2.-Inriver return, sport harvest, and spawning escapement of chinook salmon, and sport fishing effort (angler-days) directed toward all species, at the Karluk River, 1987-1996.

for 1964-1986. These record inriver returns, increasing interest in chinook salmon fishing, and poor chinook salmon returns in other areas of the state contributed to an increase in sport fishing effort on the Karluk River.

ADF&G has set a minimum biological escapement goal of 4,500 spawning chinook salmon in the Karluk River. The sport fishery is allowed to proceed without restriction (other than the normal regulatory bag limits) if it appears that the final weir count will reach 6,000 fish. This management approach assumes that the sport fishery harvest above the weir (including hook-and-release mortality) is approximately 1,500 fish, leaving 4,500 fish to spawn. These goals were set qualitatively based on average historical escapements that were continuing to provide harvestable surpluses.

THE AYAKULIK RIVER

The Ayakulik River, located about 25 miles south of the Karluk River (Figure 1), contains the only other native population of chinook salmon on Kodiak Island. Most of the land surrounding the Ayakulik River is within the Kodiak National Wildlife Refuge. Chinook salmon of Ayakulik River origin are harvested in the mixed-stock commercial fishery along the west side of Kodiak Island, along with Karluk River stocks (Table 2). Subsistence harvests did not occur in the Ayakulik River from 1985 to 1996.

Table 2.-Total commercial harvest of chinook salmon from the west side of Kodiak Island, and sport harvest from the Ayakulik River, along with inriver returns, 1987-1996.

Year	Total West Side Kodiak Commercial Harvest[a]	Inriver Return[b]	Sport Fishery[c] Harvest	Release	Effort angler-days)[d]
1987	1,554	15,636	126 [e]		638 [e]
1988	4,794	21,370	600 [e]		377 [e]
1989	0	15,432	390 [e]		1,135 [e]
1990	6,533	11,251	252 [f]	2,109 [g]	759 [h]
1991	6,060	12,988	563	2,191	1,780
1992	8,677	9,135	776	3,199	3,340
1993	11,675	7,819	1,004	4,422	4,566
1994	9,967	9,138	948	1,020	5,473
1995	7,023	17,701	200	883	1,299
1996	9,332	10,344	203	591	2,038
Mean	7,291 [i]	13,081	506	2,059	2,141

[a] Source: Commercial catch numbers extracted from ADF&G, CFMD Statewide Harvest Receipt (fish ticket) database. Includes harvest of Karluk and Ayakulik stocks, as well as other stocks of unknown origin. There was no commercial harvest in 1989 due to the *Exxon Valdez* oil spill.

[b] Brodie 1996. Census of chinook salmon passing Ayakulik River weir.

[c] Source: Mills 1988-1994; Howe et al. 1995-1997.

[d] Includes effort directed toward all species, not chinook salmon alone.

[e] Estimates are based on fewer than 12 returned surveys and are, therefore, extremely imprecise.

[f] Includes 219 chinook salmon harvested from the Ayakulik River that were coded to the wrong site number and therefore not included in the postal survey report (Mills 1991).

[g] Includes catch of 1,388 chinook salmon from the Ayakulik River that were coded to the wrong site number and therefore not included in the postal survey report (Mills 1991).

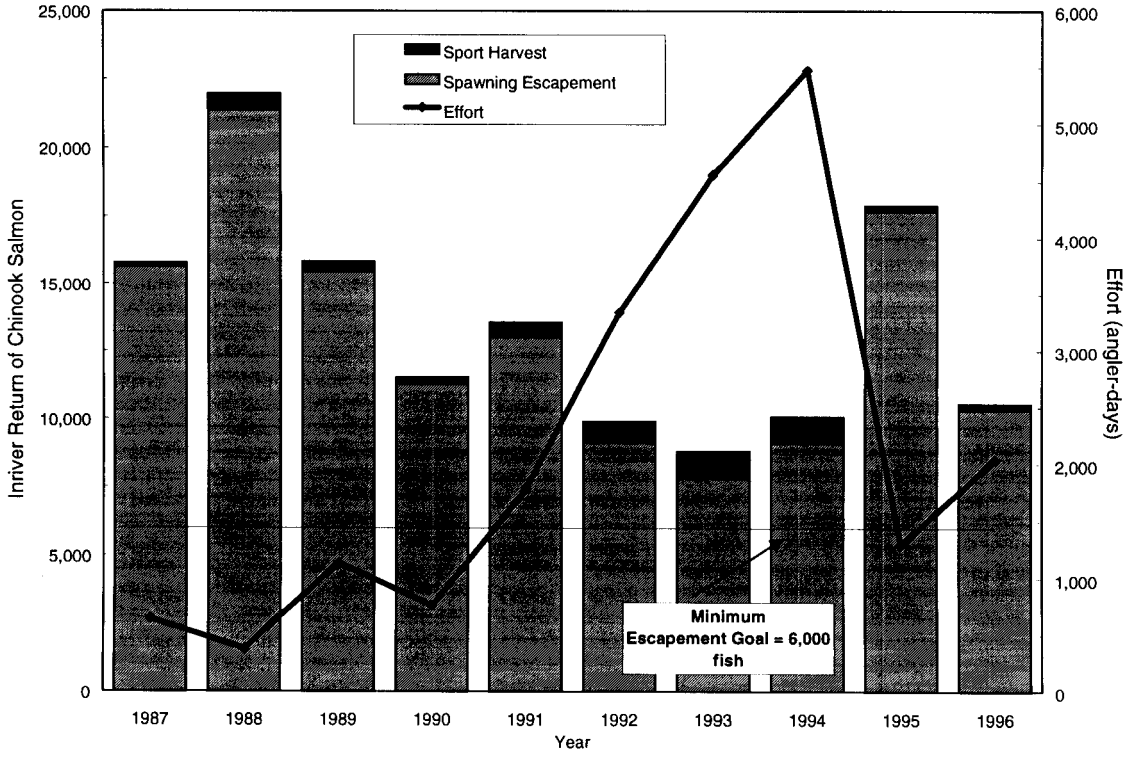
[h] Includes 420 days of effort from the Ayakulik River that were coded to the wrong site number and therefore not included in the postal survey report (Mills 1991).

[i] This average does not include the zero catch in 1989 due to the *Exxon Valdez* oil spill.

Chinook salmon are also harvested in sport fisheries on the Ayakulik River. Sport anglers typically gain access to the Ayakulik River fishery by float plane. The major access location on the upper Ayakulik River is at the confluence of the Ayakulik River and Bare Creek. Anglers either fish and camp at the landing sites or raft downstream and fish along the way. Wheel planes can land on the beach near the river mouth to pick up rafters. There is a lodge near the mouth of the river where anglers often stay for extended visits.

Sport harvest of chinook salmon from the Ayakulik River increased dramatically in 1991 through 1994, averaging over 800 chinook salmon during these 4 years (Table 2, Figure 3). Sport fishing effort for all species at the Ayakulik River tripled from 1,780 angler-days in 1991 to 5,473 angler-days in 1994 (Table 2, Figure 3).

CFMD operates a weir near the mouth of the Ayakulik River. Record inriver returns of chinook salmon occurred from 1987 through 1996 in the Ayakulik River (Schwarz 1994, Brodie 1996) (Table 2, Figure 3, Appendix C1). The average inriver return was about 13,000 chinook salmon during these record years, compared to the previous 10-year average of 7,000 (1977-1986) (Brodie 1996). The 1995 inriver return of 17,701 chinook salmon was the second highest on record.



Sources: Harvest and effort estimates from Mills 1988-1994, Howe et al. 1995-1997; inriver returns from Brodie 1996.

Figure 3.-Inriver return, sport harvest, and spawning escapement of chinook salmon, and sport fishing effort (angler-days) directed toward all species, at the Ayakulik River, 1987-1996.

ADF&G has set a minimum biological escapement goal of 6,000 spawning chinook salmon in the Ayakulik River. Similar to management of the Karluk River, the sport fishery is allowed to proceed under the normal regulatory restrictions if it appears at least 7,500 chinook salmon will be counted through the weir. This management approach assumes that harvest above the weir (including hook-and-release mortality) is approximately 1,000 fish. As with the Karluk River, these goals were set qualitatively based on average historical escapements that were continuing to provide harvestable surpluses.

In addition to annual weir counts, the United States Fish and Wildlife Service (USFWS) conducted a spawning habitat study of the Ayakulik River in 1989 (Handler and Chatto *Unpublished*). They estimated that the available spawning habitat could accommodate 5,213 spawning beds for chinook salmon. If jacks are not included, and a sex ratio of 1:1 is observed, then 10,426 adult chinook salmon could utilize the available spawning habitat. This study did not evaluate the amount of available rearing habitat, an essential parameter in determining spawning goals.

THE CHIGNIK RIVER

The Chignik River, remotely located on the Alaska Peninsula near the village of Chignik (Figure 4), is the largest chinook salmon-producing system on the south side of the Alaska Peninsula. Sport, commercial and subsistence fisheries harvest chinook salmon of Chignik River origin. Sport harvests of Chignik River chinook salmon have been relatively low compared to Karluk and Ayakulik rivers (Schwarz 1990), however there has been concern that in years of weak returns adequate escapements might not be achieved.

Chinook salmon bound for the Chignik River are harvested incidentally in the Chignik commercial sockeye salmon fishery, particularly in Chignik Lagoon. Peak chinook salmon harvests usually occur in July. Commercial harvests within Chignik Lagoon ranged from 1,579 to 5,240 chinook salmon, averaging 3,054 from 1987 to 1996 (Table 3).

Chignik River chinook salmon are also harvested in a subsistence fishery. Estimated subsistence harvest for the Chignik Management Area ranged from 9 to 165 chinook salmon from 1987-1994 (Owen *In prep*).

The sport fishery for chinook salmon primarily occurs in the 2 mile reach between the weir and the outlet of Chignik Lake. Creel surveys were conducted by the Division of Sport Fish in 1988 and 1989, with estimated harvests of 233 and 181 chinook salmon, respectively (Figure 5; Schwarz 1990). Sample sizes for the SWHS have been too small to estimate effort, harvest, and catch for the Chignik River.

CFMD operates a weir on the Chignik River located midway between Chignik Lagoon and Chignik Lake (Appendix D1). Until 1993, chinook salmon were visually counted through the weir during scheduled 10-minute counting periods. These counts were expanded to include time when counts did not take place. In 1993, chinook salmon were counted for the first 30 minutes of daily weir operation, and for 10 minutes during each hour thereafter (Owen 1993). Also until 1994, weir counts of chinook salmon did not include fish less than approximately 650 mm mid-eye to fork length (those which had spent only 1 or 2 years at sea). Chinook salmon less than 650 mm were counted as sockeye salmon due to similarity in length. Counts of chinook salmon

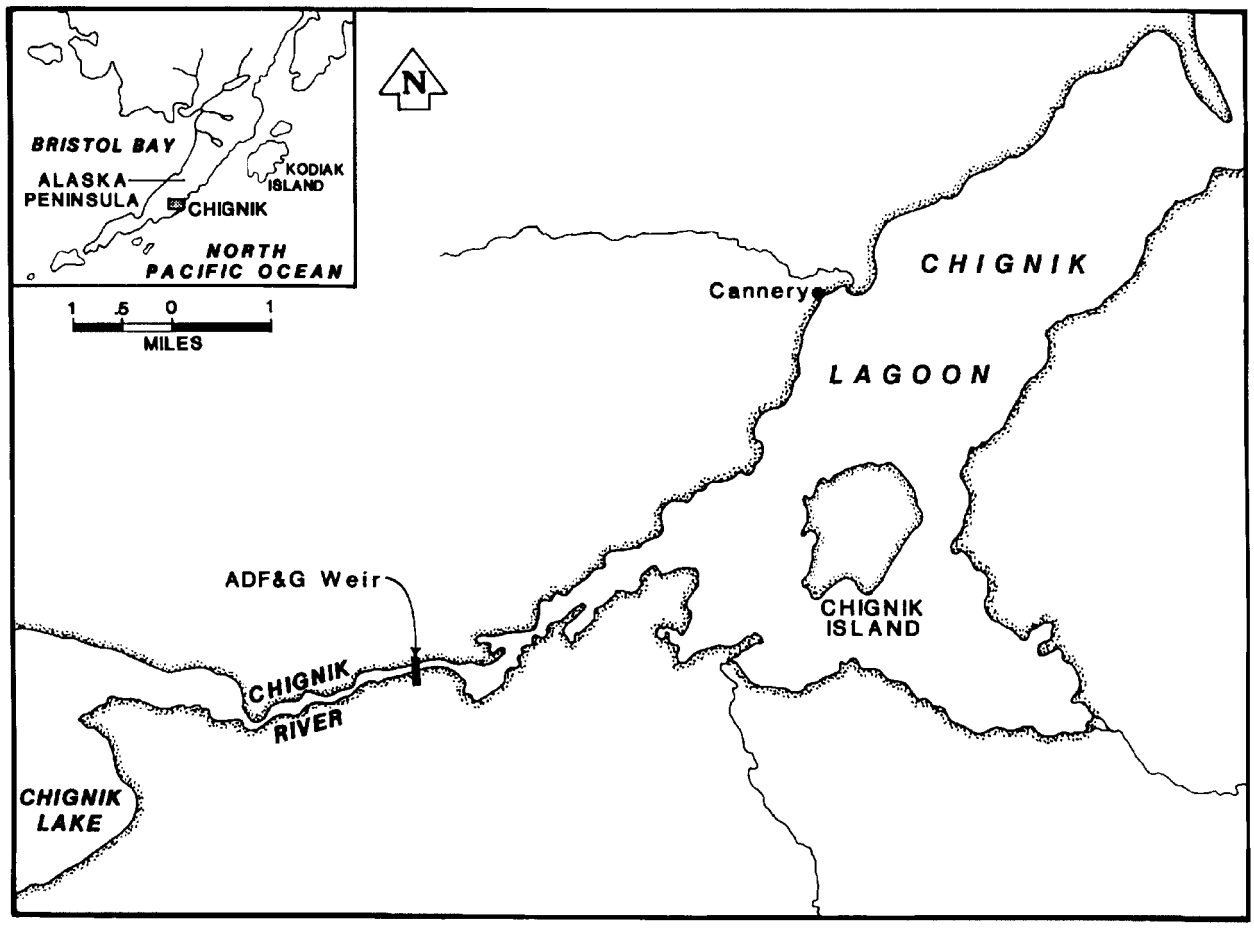


Figure 4.-Map of Chignik River on the Alaska Peninsula.

were expanded to include small fish based on estimates of the actual age composition of the run. Starting in 1994 an underwater video camera was used to count fish, so all chinook salmon, regardless of size and time of passage, were counted. Between 1987 and 1996, estimates of immigrating chinook salmon (including small fish) ranged from 2,337 to 6,123 chinook salmon, averaging 4,271 (Table 3).

In 1993 a Ricker recruitment curve (Ricker 1975) was constructed using the very limited data that were available to provide the Board of Fisheries information needed to respond to a public proposal to lower the sport fishing bag limit from three chinook salmon per day to two per year. The Ricker curve estimated maximum sustained yield at an escapement level of 3,000 fish. A minimum escapement level of 1,750 was selected because this level of escapement would still provide a large harvestable surplus, while allowing a fishery to proceed during lower escapement years. The following year, weir staff recognized an error in the methodology used to estimate escapements through the weir (Owen 1993). Owen (1993) calculated an 18% overestimation of inriver return. Because of this error, the escapement goal range of 1,750-3,000 was lowered by 18%. The current minimum escapement goal for the Chignik River is 1,435 chinook salmon. The sport fishery is managed so that a minimum of 1,435 chinook salmon will be allowed to

Table 3.-Commercial, subsistence, and sport harvest of Chignik River chinook salmon, along with inriver returns, 1987-1996.

Year	Total Chignik Area Commercial Harvest[a]	Chignik Lagoon Commercial Harvest[b]	Inriver Return[c]	Subsistence Harvest[d]	Sport Harvest[e]
1987	2,651	1,931	3,301	10	
1988	7,296	4,331	6,123	9	233
1989	3,545	3,532	4,171	11	181
1990	9,901	3,719	5,489	147	
1991	3,288	1,996	5,716	42	
1992	11,381	3,181	4,787	55	
1993	19,515	5,240	2,337	115	
1994	3,919	1,808	3,016	165	
1995	5,493	3,219	4,288		
1996	3,105	1,579	3,485		
Mean	7,009	3,054	4,271	69	207

[a] Harvest from the entire Chignik Management Area (between Kilokak Rocks and Kupreanof Point on the Alaska Peninsula). Source: Owen (*In prep*).

[b] Commercial harvest for the entire season. Source: Owen (*In prep*).

[c] For 1987-1992 these are estimated returns based on expanded 10 minute per hour counts. In 1993 estimated returns were based on 30-minute counts during the first hour of daily operation and 10-minute counts made each following hour, all counts expanded to include time not counted (Owen 1993). One- and 2-ocean-year fish were not counted at the weir for 1985-1993 due to their small size. Estimates of the proportion of 1- and 2-ocean fish were used to expand the weir estimates to yield the numbers shown above. The 1986 and 1993 estimates were adjusted by the actual percent of 1- and 2-ocean fish found in the commercial purse seine catch (7.3% for 1986; and 8.1% for the early run, 26.8% for the late run in 1993). Estimates for other years prior to 1994 were adjusted by 20.5%. In 1994 a video camera was installed to continuously count all fish passing the weir (including 1- and 2- ocean chinook salmon).

[d] Source: Owen (*In prep*).

[e] Sport harvest was estimated by creel survey in 1988 and 1989 only (Schwarz 1990).

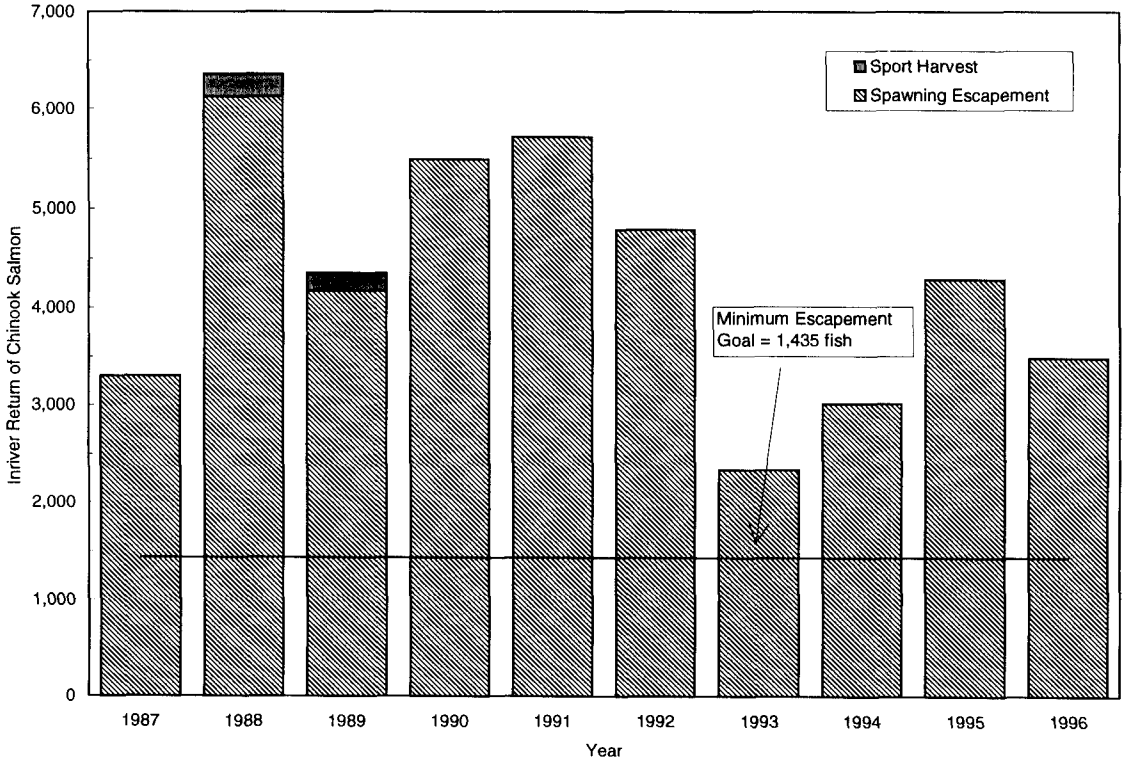
spawn. The Chignik River chinook salmon escapement goal will benefit greatly from refinements that can be made by developing brood tables based on accurate age class classification of the return data.

STUDY OBJECTIVES

In June 1993, ADF&G initiated this study to estimate sport fishing effort, harvest and catch, and age and sex compositions of the chinook salmon populations of the Karluk, Ayakulik, and Chignik rivers. This report presents results from 1995 and 1996. USFWS cooperated on the study in 1993 and 1994 by conducting a creel census on the Ayakulik River.

CFMD operates weirs on the Karluk, Ayakulik, and Chignik rivers. Their counts of chinook salmon passing through these weirs were an essential component of this study.

USFWS terminated their creel project after the 1994 season and documentation of total effort, catch, and harvest are now available only from the SWHS. However, ADF&G personnel located at the Karluk and Ayakulik weirs census all anglers who raft past the weirs. These censuses only document a portion of effort, catch, and harvest but provide inseason indices for managers.



Sources: Harvest and effort estimates from Mills 1990-1991, estimates not available for other years due to small sample sizes; inriver returns from Brodie 1996.

Figure 5.-Inriver return, sport harvest, and spawning escapement of chinook salmon at the Chignik River, 1987-1996.

The objectives of this study for the Karluk and Ayakulik rivers were to:

1. Enumerate the number of chinook salmon migrating upstream through the Karluk and Ayakulik weirs;
2. Census the fishing effort of anglers who walk or raft downstream past the weirs on the Karluk and Ayakulik rivers from 1 June to 10 July;
3. Census the harvest and catch of chinook salmon by anglers who walk or raft downstream past the weir on the Karluk and Ayakulik rivers from 1 June to 10 July;
4. Estimate the age and sex composition of the inriver return of chinook salmon through the weir on the Karluk and Ayakulik rivers in two 3-week time strata; and
5. Estimate the sex and length composition of chinook salmon harvested by anglers who walk or raft downstream past the weir on the Karluk and Ayakulik rivers.

Objectives for the Chignik River portion of the study were to:

6. Estimate the age and sex composition of the commercial harvest of chinook salmon in the Chignik River Lagoon in two 2-week time strata during July.

METHODS

DATA COLLECTION

Inriver Return

Daily counts by species of fish passing the weir were conducted at the weirs on the Karluk, Ayakulik, and Chignik rivers by CFMD staff as outlined in their Divisional Operational Plan for weir operation.

Age and Sex Composition of Inriver Return

During 1995 and 1996, the inriver returns of chinook salmon to the Karluk and Ayakulik rivers were sampled at weir traps. Sampling was stratified into two 3-week intervals at each system. Sampling goals were established at 150 fish for 1-20 June and 150 fish for 21 June-10 July. At least 50 fish were to be sampled each week. In 1995, the 50 sampled fish were obtained by sampling 10 fish per day for 5 days. In 1996, on 1 or 2 days each week, all chinook salmon passing the weir were stopped in the weir trap and sampled for length, sex, and age until the goal of 50 was met. The starting day for each sampling period was chosen randomly. Neither sampling strategy proved to be more effective than the other. However, other weir operations, such as counting fish, were less affected if chinook salmon were sampled only 1 or 2 days each week.

At the Chignik River a weir trap is not available so the commercial purse seine harvest from inside Chignik Lagoon was sampled. Purse seine gear is fairly nonselective with regard to size, so samples from the purse seine harvest in this terminal fishery were assumed to be indicative of the Chignik River escapement. Sampling was stratified into two 2-week intervals (1 July-15 July and 16 July-31 July) with sample goals of 150 fish from each interval.

Length from mid-eye to fork-of-tail was recorded to the nearest millimeter. Sex was identified based on external characteristics. Three scales were removed from each chinook salmon from the left side of the body, at a point on a diagonal line from the posterior insertion of the dorsal fin

to the anterior insertion of the anal fin, two rows above the lateral line (Welander 1940). Scales were mounted on a gum card. If the preferred scales could not be obtained, scales were taken from as close to the preferred scales as possible. However, scales were only taken from the area bounded dorsally by the fourth row of scales above the lateral line, ventrally by the lateral line, and between lines drawn vertically from the posterior insertion of the dorsal fin and the anterior insertion of the anal fin. If no scales were available in the preferred area on the left side of the fish, scales were collected from the preferred area on the right side of the fish. Ages of sampled chinook salmon were determined from scales using criteria described in Mosher (1969).

Sport Harvest and Effort at the Weirs

In 1995 and 1996, technicians were stationed at the Karluk and Ayakulik weirs, one at each weir. Technicians interviewed each angler in each raft party separately (not just a party interview for the entire raft) as they passed through the weir. Technicians collected the following information:

1. Number of days fished.
2. Number of chinook and sockeye salmon, steelhead, and Dolly Varden kept.
3. Number of chinook and sockeye salmon, steelhead, and Dolly Varden released.
4. Type of resident:
    a. Non-resident of the State of Alaska.
    b. Alaska resident living outside of Kodiak Island.
    c. Alaska resident living on Kodiak Island.
5. Guided or unguided (guide present with anglers is necessary to be considered guided).

Anglers who walked upriver past the weir were also to be interviewed as they returned.

On the Ayakulik River, clients from a lodge located on the ocean beach walked upriver daily to fish. Lodge clients were not interviewed directly because they stayed for a full week, and interviewing the same 10-15 anglers each day might have annoyed them, compromising the quality of the data given the technician. The lodge manager had established relationships with the clients and easily interviewed the anglers at the end of each day. Allowing the manager to provide a daily summary of angling activity provided the most accurate and complete data possible. The daily summary included:

1. Number of anglers who fished.
2. Number by species of chinook and sockeye salmon, steelhead, and Dolly Varden kept by all lodge clients.
3. Number by species of chinook and sockeye salmon, steelhead, and Dolly Varden released by all lodge clients.
4. Residency: In the past, all clients were non-residents. The residency of each group was determined on the first day a group arrived. If residency was mixed for a group, Items 1, 2, and 3 were separated by residence.

Inseason data collected on the Karluk and Ayakulik rivers were used as an index of harvest. Total effort, and catch and harvest of chinook salmon at the Karluk, Ayakulik, and Chignik rivers were estimated by the SWHS.

Sex Composition of the Sport Harvest

The sport harvest of chinook salmon from the Karluk and Ayakulik rivers was sampled for sex and length at the weir. Our goal was to sample 12 chinook salmon per week that had not been filleted or headed. Data collection was as described above. This goal was not met on the Karluk River because the majority of rafters cleaned their fish before passing through the weir, as they generally have a pick-up time scheduled to coincide with their exiting the fishery. The goal was met on the Ayakulik River by sampling predominately fish caught by lodge clients. These fish were brought through the weir intact on their way to being processed at the lodge. All available chinook salmon harvested by rafters were sampled as well. We assumed that fish harvested by guided anglers were representative of all fish harvested on the Ayakulik River.

The sport harvest of Chignik River chinook salmon was not sampled because estimates of sport effort, and catch and harvest of chinook salmon are not available from the SWHS.

DATA ANALYSIS

Inriver Return at the Karluk and Ayakulik Rivers

The proportion of chinook salmon in age/sex class j sampled from the inriver return at the Karluk and Ayakulik rivers during temporal stratum i and its variance was estimated as a binomial proportion (Cochran 1977) by:

$$\hat{p}_{ij} = \frac{n_{ij}}{n_i}, \text{ and} \tag{1}$$

$$\mathrm{Var}(\hat{p}_{ij}) = \left[\frac{N_i - n_i}{N_i}\right]\frac{\hat{p}_{ij}\left(1 - \hat{p}_{ij}\right)}{n_i - 1}, \tag{2}$$

where:

n_{ij} = the number of chinook salmon in age/sex class j during stratum i,

n_i = the total number of chinook salmon sampled during stratum i, and

N_i = the inriver return of chinook salmon counted during stratum i.

The abundance of chinook salmon by age/sex class was estimated as the product of the inriver return and the proportion:

$$\hat{N}_{ij} = N_i \hat{p}_{ij}, \tag{3}$$

and its variance estimated by:

$$\mathrm{Var}(\hat{N}_{ij}) = N_i^2 \mathrm{Var}(\hat{p}_{ij}). \tag{4}$$

Chi-square statistics were calculated to test the null hypothesis that the age/sex composition of the inriver return did not change between the early and late temporal strata shown below.

Location and Year	Early Stratum	Late Stratum
Karluk River 1995	15 May - 20 June	21 June - 26 Sept
Karluk River 1996	24 May - 20 June	21 June - 27 Sept
Ayakulik River 1995	27 May - 20 June	21 June - 28 Aug
Ayakulik River 1996	24 May - 20 June	21 June - 25 Aug
Chignik River 1995	30 May - 7 July	8 July - 25 Aug
Chignik River 1996	26 May - 7 July	8 July - 4 Sept

If we failed to detect differences at $\alpha = 0.05$ then the data were pooled across temporal strata. If differences existed then the proportions and number of chinook salmon migrating upstream through the weir were estimated separately for each stratum. The total number of chinook salmon of each age/sex class, and their variances, were the sum of the stratum estimates.

Sport Harvest and Spawning Escapement at the Karluk and Ayakulik Rivers

Total sport harvest at the Karluk and Ayakulik rivers was estimated by the SWHS. Because nearly all of the harvest occurs upstream of the weir at the Karluk and Ayakulik rivers, spawning escapement was estimated by subtracting sport harvest from inriver return. The variance of the estimated spawning escapement was the same as the variance of the estimated sport harvest; the inriver return was a complete census and was estimated without sampling error. Estimates of sport harvest in the Chignik River are not available for 1995 and 1996.

The proportion of chinook salmon harvested by anglers who moved downstream past the Karluk or Ayakulik weir that was of sex j, and its variance, was estimated using equations (1) and (2). The total number of chinook salmon of sex j harvested above the weir was estimated by:

$$\hat{H}_j = \hat{H}\hat{p}_j, \tag{5}$$

and its variance estimated by (Goodman 1960):

$$\mathrm{Var}(\hat{H}_j) = \hat{H}^2\mathrm{Var}(\hat{p}_j) + \hat{p}_j^2\mathrm{Var}(\hat{H}) - \mathrm{Var}(\hat{p}_j)\mathrm{Var}(\hat{H}), \tag{6}$$

where:

$\hat{H}$ and $\mathrm{Var}(\hat{H})$ = harvest and variance of harvest estimated from the SWHS, and

$\hat{p}_j$ and $\mathrm{Var}(\hat{p}_j)$ = proportion and variance of the proportion of chinook salmon of class j.

We assumed that chinook salmon harvested by anglers censused at the weir were representative of the entire harvest upstream of the weir. In 1994 sex composition of the harvest at the Karluk River did not differ between anglers who moved past the weir and those exiting the fishery upstream of the weir at the Portage area (Schwarz 1996). Sex composition did differ at the

Ayakulik River between harvested chinook salmon sampled at the weir (34% females) and those sampled upstream of the weir at Bare Creek (60% females; Schwarz 1996). Therefore, our 1995 and 1996 estimates of composition of the harvest at the Ayakulik River may be biased in favor of males. However, any resulting bias in sex composition of the spawning escapement would be very small, since harvest averages only 4% of the inriver return on the Ayakulik River.

Because all anglers at the Karluk and Ayakulik rivers who moved downstream past the weirs were interviewed, angler interview data were summed to calculate effort, catch, and harvest at the weir. These statistics were used for inseason indices only to aid managers in deciding if inseason actions were necessary to meet escapement goals.

Chignik River

Fish ticket data from boats fishing in the Chignik River Lagoon and daily counts of chinook salmon through the weir on the Chignik River were considered complete censuses. The estimated proportion and number, and their respective variances, by age/sex class, and the chi-square test to examine temporal differences, followed procedures outlined in the Karluk/Ayakulik section. We assumed age and sex compositions of the commercial harvest were equal to those of the inriver return.

The proportion by age/sex class from the commercial harvest data was also applied to the inriver return of the Chignik River. The number of chinook salmon in the inriver return by age/sex class and its variance were estimated using equations 5 and 6.

The total return of chinook salmon to the Chignik River was estimated by summing commercial harvest and inriver return. Age and sex composition of the total return was estimated using equations (1)-(4), based on fish sampled in the commercial harvest.

RESULTS

KARLUK RIVER IN 1995

Inriver Return

Inriver return to the Karluk River in 1995 was 12,657 chinook salmon.

We determined ages for 242 of 298 chinook salmon sampled at the weir. As in past years, age composition differed significantly between time strata (ages 1.1 through 1.5 only; $\chi^2 = 26.6$, df = 4, P = 0.001). Therefore, estimates of return by age and sex were stratified by time stratum. Sex composition did not differ between time strata ($\chi^2 = 0.67$, df = 1, P = 0.41). Females comprised primarily age-1.4 fish during both strata; whereas males comprised mostly age-1.3 and -1.4 fish during the first stratum, and age-1.1 through -1.4 fish during the second stratum (Appendices E1 and E2).

Of the 12,657 chinook salmon in the inriver return, an estimated 7,426 (SE = 398) were age 1.4, 1,723 (SE = 286) were age 1.3, and 1,652 (SE = 250) were age 1.2 (Table 4). An estimated 7,588 (SE = 404) chinook salmon were males and 5,069 (SE = 404) were females (Table 4), for a sex ratio of males to females of 1.5:1.0.

Mean length of females was 825 mm (SE = 4) during the first period and 810 mm (SE = 6) during the second period (Appendices E1 and E2). Mean length of males was 786 mm (SE = 9) during the first period and 709 mm (SE = 15) during the second period (Appendices E1 and E2).

Table 4.-Estimates of inriver return by age and sex for Karluk River chinook salmon, 1995 and 1996.

	Age									
	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	2.5	Total
1995										
Females										
Percent	0.0	0.7	2.7	32.1	3.4	0.0	0.0	1.2	0.0	40.0
SE	0.0	0.5	1.0	3.1	1.2	0.0	0.0	0.7	0.0	3.2
Return	0	86	342	4,065	426	0	0	150	0	5,069
SE	0	60	129	386	150	0	0	87	0	404
Males										
Percent	3.1	12.4	10.9	26.6	4.4	0.3	1.0	1.3	0.0	60.0
SE	1.0	1.9	2.1	2.9	1.4	0.3	0.7	0.8	0.0	3.2
Return	388	1,566	1,381	3,361	553	43	127	170	0	7,588
SE	124	246	262	366	172	43	88	98	0	404
Total										
Percent	3.1	13.1	13.6	58.7	7.7	0.3	1.0	2.5	0.0	100.0
SE	1.0	2.0	2.3	3.1	1.8	0.3	0.7	1.0	0.0	0.0
Return	388	1,652	1,723	7,426	978	43	127	319	0	12,657
SE	124	250	286	398	224	43	88	130	0	0
1996										
Females										
Percent	0.0	0.6	5.4	24.0	1.7	0.0	2.0	3.3	0.6	37.5
SE	0.0	0.6	1.9	3.7	1.0	0.0	1.4	1.5	0.6	4.2
Return	0	57	540	2,417	171	0	199	327	57	3,768
SE	0	56	193	371	97	0	138	149	56	420
Males										
Percent	1.0	15.8	16.0	18.8	2.3	2.1	5.9	0.6	0.0	62.5
SE	1.0	3.3	3.2	3.3	1.1	1.3	2.0	0.6	0.0	4.2
Return	99	1,591	1,607	1,891	228	213	597	57	0	6,283
SE	99	330	320	335	111	127	200	56	0	420
Total										
Percent	1.0	16.4	21.4	42.9	4.0	2.1	7.9	3.8	0.6	100.0
SE	1.0	3.3	3.5	4.3	1.4	1.3	2.4	1.6	0.6	0.0
Return	99	1,648	2,147	4,308	399	213	796	384	57	10,051
SE	99	334	356	429	145	127	239	158	56	0

Total Effort, Catch and Harvest

In 1995, anglers caught 3,897 (SE = 664) and harvested 1,284 (SE = 230) chinook salmon, expending 6,928 (SE = 998) angler-days on the Karluk River for all fish species (Howe et al. 1996).

We measured 46 chinook salmon harvested by anglers censused at the weir, including 25 female and 21 male chinook salmon. Therefore, the total harvest was estimated to include 698 females (SE = 156) and 586 males (SE = 141). Harvested females averaged 835 mm (SE = 11) and males averaged 777 mm (SE = 14).

Spawning Escapement

In 1995, spawning escapement to the Karluk River was estimated to be 11,373 (SE = 230) chinook salmon, of which 7,002 (SE = 428) were males and 4,371 (SE = 433) were females.

Inseason Indices of Effort, Catch, and Harvest

During the 1995 survey, we interviewed 380 anglers at the weir. These anglers harvested 492 chinook salmon, released 2,411 chinook salmon (83% of those caught), and expended 1,677 angler-days of effort (Table 5).

Anglers also caught sockeye salmon, steelhead and rainbow trout *O. mykiss*, and Dolly Varden *Salvelinus malma* (Appendix G1). Most anglers interviewed at the Karluk River were unguided and were nonresidents (Table 6). Very few anglers reported harvesting more than the possession limit of three fish during their trip (Table 7).

KARLUK RIVER IN 1996

Inriver Return

Inriver return to the Karluk River in 1996 was 10,051 chinook salmon.

We determined ages for 143 of 215 chinook salmon sampled at the Karluk River weir. As in past years, age composition differed significantly between time periods (before versus after 21 June; ages 1.2 through 1.5 only; $\chi^2 = 11.4$, df = 3, P = 0.009). Therefore, estimates were stratified by period. Sex composition did not differ between time periods ($\chi^2 = 2.95$, df = 1, P = 0.09). Females were composed primarily of age-1.4 fish during both periods, whereas males were composed mostly of age-1.3 and -1.4 fish during the first period, and of age-1.2 through -1.4 fish during the second period (Appendices E3 and E4).

An estimated 4,308 (SE = 429) chinook salmon were age 1.4, 2,147 (SE = 356) were age 1.3, and 1,648 (SE = 334) were age 1.2 (Table 4). An estimated 6,283 (SE = 420) were males and 3,768 (SE = 420) were females (Table 4), for a male to female sex ratio of 1.7:1.0.

Mean length of females was 828 mm (SE = 6) during the first period and 828 mm (SE = 8) during the second period. Mean length of males was 741 mm (SE = 12) during the first period and 689 mm (SE = 21) during the second period (Appendices E3 and E4).

Total Effort, Catch and Harvest

In 1996, anglers caught 2,382 (SE = 525) chinook salmon and harvested 769 (SE = 181) chinook salmon, expending 6,237 (SE = 1,033) angler-days on the Karluk River for all species (Howe et al. 1997). Twenty-six sport-harvested chinook salmon were measured at the weir, including

Table 5.-Comparison of harvest and release of chinook salmon estimated by the Statewide Harvest Survey, creel surveys, and censuses at the Karluk and Ayakulik rivers, 1991-1996.

					Anglers Censused at Weir[b]			
	SWHS[a]		Creel Survey[b]		Number of	Effort		
Year	Harvest	Release	Harvest	Release	Anglers	(angler-days)	Harvest	Release
Karluk River								
1991	1,599	3,119			162			
1992	856	2,754			235	807	340	840
1993	1,634	6,735	569 [c]	2,566 [c]	244	1,088	369	2,484
1994	1,483	2,174	896 [d]	4,339 [d]	506	1,650	493	3,385
1995	1,284	2,613			380	1,677	492	2,411
1996	769	1,613			329	1,727	406	2,996
AVG	1,271	3,168	732	3,453	309	1,390	420	2,423
Ayakulik River								
1993	1,004	4,422	808 [e]	2,878 [e]	150	598	433	1,961
1994	948	1,020	739 [e]	2,752 [e]	203	926	477	1,898
1995	200	883			126	606	296	2,445
1996	203	591			135	446	292	1,299
AVG	589	1,729	774	2,815	154	644	375	1,901

[a] Statewide Harvest Survey; Mills 1992-1994; Howe et al. 1995-1997.

[b] Schwarz 1996.

[c] Does not include anglers who exited at the Portage.

[d] Does not include anglers who fished downstream of the weir.

[e] Census by USFWS.

15 males and 11 females. Total harvest was made up of 444 males (SE = 128) and 325 (SE = 128) females. Harvested females averaged 833 (SE = 16) mm; males averaged 784 mm (SE = 31).

Spawning Escapement

In 1996, spawning escapement to the Karluk River was an estimated 9,282 (SE = 181) chinook salmon, of which 5,839 (SE = 439) were males and 3,443 (SE = 439) were females).

Inseason Indices of Effort, Catch, and Harvest

At the weir in 1996, anglers harvested 406 chinook salmon and released 2,996 fish (88% of those caught). Anglers expended 1,727 angler-days of effort (Table 5). Anglers also caught sockeye

salmon, steelhead and rainbow trout, and Dolly Varden (Appendix G1). Anglers tended to be unguided (64%) and nonresidents (79%) (Table 6).

Very few anglers at the Karluk River reported harvesting more than the possession limit of three chinook salmon during their trip (Table 7). Fish that are frozen or consumed are not considered part of the angler's possession limit, but freezers are not readily available on the Karluk River, so few anglers keep more than three fish.

Table 6.-Effort, and harvest and release of chinook salmon by anglers censused at the Karluk River weir (by angler type and residency), 1995 and 1996.

	Angler Type		Residency			
	Guided	Unguided	Local	Other AK	Nonresident	Total
1995						
Number of Anglers	133	247	17	26	334	380
Effort (Angler days)	366	1,311	74	126	1,465	1,677
Harvest	129	363	41	25	424	492
Release	473	1,938	78	143	2,125	2,411
1996						
Number of Anglers	117	212	22	46	260	330
Effort (Angler days)	677	1,042	81	162	1,475	1,727
Harvest	160	245	40	43	322	406
Release	1,137	1,854	152	147	2,672	2,996

AYAKULIK RIVER IN 1995

Inriver Return

Inriver return to the Ayakulik River in 1995 was 17,701 chinook salmon.

We determined ages for 211 of 292 chinook salmon sampled at the weir. Estimates of return by age were stratified by time period because, as in past years, age composition differed significantly between time periods (before vs. after June 20; ages 1.1 through 1.5 only; $\chi^2 = 16.4$, df = 4, P = 0.002), although sex composition did not differ between time periods ($\chi^2 = 0.94$, df = 1, P = 0.33). Females comprised primarily age-1.4 fish during both periods, whereas males comprised mostly age-1.4 fish during the first period, and age-1.1 through -1.4 fish during the second period (Appendices F1 and F2).

An estimated 10,633 (SE = 590) chinook salmon in the inriver return were age 1.4, 2,481 (SE = 402) were age 1.2, and 2,151 (SE = 406) were age 1.3 (Table 8). An estimated 11,157 (SE = 594) chinook salmon were males and 6,544 (SE = 594) were females (Table 8), for a sex ratio of males to females of 1.7:1.0.

Mean length of females was 826 mm (SE = 5) during the first period and 829 mm (SE = 9) during the second period (Appendices F1 and F2). Mean length of males was 782 mm (SE = 16) during the first period and 695 mm (SE = 19) during the second period (Appendices F1 and F2).

Mean length of all fish during the early stratum was 800 mm (SE = 9); during the late stratum mean length was 743 mm (SE = 14) (Appendices F1 and F2).

Total Effort, Catch and Harvest

In 1995, anglers expended 1,299 (SE = 343) angler-days on the Ayakulik River for all fish species, catching 1,083 (SE = 423) chinook salmon and harvesting 200 (SE = 89) chinook salmon (Howe et al. 1996).

Of 54 chinook salmon harvested by anglers passing the weir, 26 were females and 28 were males. Therefore, the total harvest was estimated to include 96 females (SE = 44) and 104 males (SE = 48). Harvested females averaged 838 (SE = 6) mm, and males averaged 811 (SE = 21) mm in length.

Table 7.-Distribution of harvest for anglers censused at the Karluk River weir, 1995 and 1996.

	Number of Chinook Salmon Kept During Trip								Total
	0	1	2	3	4	5	6	>6	Anglers
1995									
Guided Anglers									
Number	46	52	28	7	0	0	0	0	133
Percent	35	39	21	5	0	0	0	0	
Unguided Anglers									
Number	70	46	103	19	5	1	0	3	247
Percent	28	19	42	8	2	0	0	1	
Total at Weir									
Number	116	98	131	26	5	1	0	3	380
Percent	31	26	34	7	1	0	0	1	
1996									
Guided Anglers									
Number	31	27	48	7	4	0	0	0	117
Percent	26	23	41	6	3	0	0	0	
Unguided Anglers									
Number	75	63	63	6	0	0	1	4	212
Percent	35	30	30	3	0	0	0	2	
Total at Weir									
Number	106	91	111	13	4	0	1	4	330
Percent	32	28	34	4	1	0	0	1	

Table 8.-Estimates of inriver return by age and sex for Ayakulik River chinook salmon, 1995 and 1996.

	Age										
	0.4	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	2.5	Total
1995											
Females											
Percent	0.5	0.0	0.8	3.1	29.7	2.2	0.0	0.0	0.5	0.0	37.0
SE	0.5	0.0	0.6	1.3	3.2	1.0	0.0	0.0	0.5	0.0	3.4
Return	97	0	144	557	5,264	385	0	0	97	0	6,544
SE	97	0	101	223	562	171	0	0	97	0	594
Males											
Percent	0.0	5.2	13.2	9.0	30.3	4.0	0.4	0.0	1.0	0.0	63.0
SE	0.0	1.4	2.2	2.0	3.2	1.4	0.4	0.0	0.7	0.0	3.4
Return	0	915	2,337	1,594	5,369	701	72	0	169	0	11,157
SE	0	256	394	352	561	244	72	0	120	0	594
Total											
Percent	0.5	5.2	14.0	12.2	60.1	6.1	0.4	0.0	1.5	0.0	100.0
SE	0.5	1.4	2.3	2.3	3.3	1.7	0.4	0.0	0.9	0.0	0.0
Return	97	915	2,481	2,151	10,633	1,087	72	0	266	0	17,701
SE	97	256	402	406	590	295	72	0	153	0	0
1996											
Females											
Percent	0.0	0.0	1.8	9.0	21.7	2.5	0.0	2.2	0.0	0.0	37.2
SE	0.0	0.0	1.1	2.2	3.2	1.2	0.0	1.2	0.0	0.0	3.7
Return	0	0	187	934	2,241	261	0	224	0	0	3,847
SE	0	0	111	232	332	122	0	127	0	0	381
Males											
Percent	0.0	4.0	23.1	14.8	17.0	1.4	0.0	2.5	0.0	0.0	62.8
SE	0.0	1.5	3.1	2.5	2.9	0.9	0.0	1.2	0.0	0.0	3.7
Return	0	411	2,389	1,530	1,755	149	0	261	0	0	6,497
SE	0	159	321	264	298	91	0	122	0	0	381
Total											
Percent	0.0	4.0	24.9	23.8	38.6	4.0	0.0	4.7	0.0	0.0	100.0
SE	0.0	1.5	3.2	3.2	3.7	1.5	0.0	1.7	0.0	0.0	0.0
Return	0	411	2,576	2,464	3,996	411	0	486	0	0	10,344
SE	0	159	332	330	385	151	0	174	0	0	0

Spawning Escapement

In 1995, spawning escapement to the Ayakulik River was 17,501 (SE = 89) chinook salmon, of which 11,053 (SE = 596) were males and 6,448 (SE = 596) were females.

Inseason Indices of Effort, Catch, and Harvest

In 1995, anglers interviewed at the weir harvested 296 and released 2,445 chinook salmon, a release rate of 89% (Table 5). Anglers expended 606 angler-days of effort. These anglers tended to be unguided nonresidents (Table 9). These estimates are not comparable to the 1993 and 1994 surveys, which documented the entire catch for the river, because 1995 data do not include anglers exiting the fishery at Bare Creek.

In 1995, 40% of guided anglers harvested more than three chinook salmon (Table 10). More than three fish can be legally harvested if they are less than 20 inches in length, or if the fish are frozen or consumed (and therefore no longer in possession). Freezers are present at the lodge located at the river mouth, making it possible for anglers at the Ayakulik to increase their harvest. In addition to chinook salmon, anglers caught sockeye salmon, steelhead and rainbow trout, and Dolly Varden (Appendix G2).

AYAKULIK RIVER IN 1996

Inriver Return

Inriver return to the Ayakulik River in 1996 was 10,344 chinook salmon.

Age was determined for 191 of 300 chinook salmon at the Ayakulik River weir. Age composition did not differ significantly between time periods (before vs. after June 20; ages 1.1 through 1.5 only; $\chi^2 = 6.4$, df = 4, P = 0.169), but sex composition did differ between time periods ($\chi^2 = 8.27$, df = 1, P = 0.004). Therefore, estimates of return by sex and age were stratified by time period. During both periods, females were composed primarily of age-1.4 fish, and males were composed of ages-1.2 through -1.4 fish (Appendices F3 and F4).

Table 9.-Effort, and harvest and release of chinook salmon, by sport anglers censused at the Ayakulik River weir (by angler type and residency), 1995 and 1996.

	Angler Type		Residency			
	Guided	Unguided	Local	Other AK	Nonresident	Total
1995						
Number of Anglers	35	91	26	21	78	126
Effort (Angler days)	235	371	68	54	483	606
Harvest	179	117	35	20	241	296
Release	1,545	900	157	200	2,088	2,445
1996						
Number of Anglers	34	101	34	35	66	136
Effort (Angler days)	290	156	56	58	332	446
Harvest	238	54	17	26	249	292
Release	1,202	97	5	8	1,294	1,299

Table 10.-Distribution of harvest of chinook salmon for anglers censused at the Ayakulik River weir, 1995 and 1996.

	Number of Chinook Salmon Kept During Trip								Total Anglers
	0	1	2	3	4	5	6	>6	
1995									
Guided Anglers									
Number	13	5	3	0	1	1	1	11	35
Percent	37	14	9	0	3	3	3	31	
Unguided Anglers									
Number	27	22	31	11	0	0	0	0	91
Percent	30	24	34	12	0	0	0	0	
Total at Weir									
Number	40	27	34	11	1	1	1	11	126
Percent	32	21	27	9	1	1	1	9	
1996									
Guided Anglers									
Number	9	0	2	0	1	0	1	21	34
Percent	26	0	6	0	3	0	3	62	
Unguided Anglers									
Number	70	9	21	1	0	0	0	0	101
Percent	69	9	21	1	0	0	0	0	
Total at Weir									
Number	80	9	23	1	1	0	1	21	136
Percent	59	7	17	1	1	0	1	15	

An estimated 3,996 (SE = 385) chinook salmon of the inriver return were age 1.4, 2,576 (SE = 332) were age 1.2, and 2,464 (SE = 330) were age 1.3 (Table 8). An estimated 6,497 (SE = 381) chinook salmon were males and 3,847 (SE = 381) were females (Table 8), for a sex ratio of males to females of 1.7:1.0.

Mean length of females was 803 mm (SE = 7) during the first period and 826 mm (SE = 9) during the second period (Appendices F3 and F4). Mean length of males was 698 mm (SE = 17) during the first period and 682 mm (SE = 15) during the second period (Appendices F3 and F4).

Total Effort, Catch and Harvest

Anglers harvested 203 (SE = 84) chinook salmon, out of a total catch of 794 (SE = 304) chinook salmon at the Ayakulik River in 1996; sport fishing effort was 2,038 (SE = 468) angler-days (Howe et al. 1997). We measured 80 chinook salmon harvested by anglers passing the weir, including 52 male and 28 female chinook salmon. Total harvest was estimated to include 132

(SE = 55) males and 71 (SE = 55) females. Harvested males averaged 855 mm (SE = 15), females 848 mm (SE = 11).

Spawning Escapement

In 1996, spawning escapement to the Ayakulik River was 10,141 (SE = 84) chinook salmon. Of those, 6,365 (SE = 385) were males and 3,776 (SE = 385) were females.

Inseason Indices of Effort, Catch, and Harvest

In 1996, anglers passing the Ayakulik River weir and those at the lodge harvested 292 and released 1,299 chinook salmon (Table 5). These anglers expended 446 angler-days of effort. As in 1995, anglers passing the weir in 1996 tended to be unguided nonresidents (Table 9). In addition to chinook salmon, anglers caught sockeye salmon, steelhead and rainbow trout, and Dolly Varden (Appendix G2). In 1996, 68% of guided anglers harvested more than three chinook salmon (Table 10).

CHIGNIK RIVER IN 1995

Commercial fisheries in Chignik Lagoon harvested 3,219 chinook salmon in 1995. The inriver return was 4,288 chinook salmon. Therefore, total return was 7,507 chinook salmon. Sport harvest is unavailable from the SWHS, so we could not calculate spawning escapement.

Age and sex were determined for 332 of 365 chinook salmon sampled from the Chignik Lagoon commercial fishery, which we assumed to be representative of the inriver escapement. Age composition did not differ between fish sampled before versus after 7 July (ages 1.1 through 1.5 only, $\chi^2 = 6.31$, df = 4, P = 0.177), and sex composition did not differ between time periods ($\chi^2 = 0.01$, df = 1, P = 0.93). Therefore the return was not stratified by time. Females comprised primarily age-1.4 fish; males age-1.2, -1.3, and -1.4 fish (Table 11). Mean length was 883 mm (SE = 5) for females and 819 mm (SE = 12) for males.

The total return comprised an estimated 4,726 (SE = 195) age-1.4, 1,063 (SE = 141) age-1.3, and 904 (SE = 131) age-1.2 chinook salmon. Returning fish consisted of 3,799 (SE = 202) females and 3,708 (SE = 202) males, for a male to female sex ratio of 0.97:1.0 (Table 11).

CHIGNIK RIVER IN 1996

Commercial fisheries harvested 1,579 chinook salmon in Chignik Lagoon in 1996. Inriver return was 3,485 chinook salmon. Therefore, total return was 5,064 chinook salmon. Sport harvest is unavailable from the SWHS, so we could not calculate spawning escapement.

Age and sex were determined for 105 of 136 chinook salmon sampled from the Chignik Lagoon commercial fishery. Age composition did not differ between fish sampled before versus after 7 July (ages 1.2 through 1.5 only, $\chi^2 = 0.87$, df = 3, P = 0.833). Neither did sex composition differ between time periods ($\chi^2 = 0.05$, df = 1, P = 0.82). Therefore the return was not stratified by time period. An estimated 2,653 (SE = 295) chinook salmon of the total return were age 1.4, 1,254 (SE = 212) were age 1.3, and 434 (SE = 212) were age 1.2. Both females and males were composed primarily of age-1.3 and -1.4 fish (Table 12). Mean length was 862 mm (SE = 8) for females and 836 mm (SE = 22) for males. Returning fish consisted of 2,990 (SE = 242) females and 2,074 (SE = 242) males, for a male to female sex ratio of 0.7:1.0 (Table 12).

Table 11.-Age and sex composition estimates for the total return of chinook salmon to Chignik River and Lagoon, 1 June through 24 August 1995. (Samples taken from commercial purse seine harvest in Chignik Lagoon.)

	Age									
	0.4	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	Total
Females										
Sample Size	0	0	4	18	133	8	0	1	4	168
Percent			1.2	5.4	40.1	2.4		0.3	1.2	50.6
SE Percent			0.6	1.2	2.6	0.8		0.3	0.6	2.7
Total Return	0	0	90	407	3,007	181	0	23	90	3,799
SE Total Return			44	91	198	62		22	44	202
Mean Length			674	804	901	911		840	911	883 [a]
SE Mean Length			23	13	4	17			25	5
Minimum Length			610	650	775	835		840	850	365
Maximum Length			710	870	985	980		840	970	995
Males										
Sample Size	0	8	36	29	76	13	1	0	1	164
Percent		2.4	10.8	8.7	22.9	3.9	0.3		0.3	49.4
SE Percent		0.8	1.7	1.5	2.3	1.0	0.3		0.3	2.7
Total Return	0	181	814	656	1,718	294	23	0	23	3,708
SE Total Return		62	125	114	169	78	22		22	202
Mean Length		398	659	763	929	959	710		945	819 [b]
SE Mean Length		8	9	13	8	22				12
Minimum Length		360	555	615	680	805	710		945	360
Maximum Length		435	785	880	1,060	1,090	710		945	1,090
All										
Sample Size	0	8	40	47	209	21	1	1	5	332
Percent		2.4	12.0	14.2	63.0	6.3	0.3	0.3	1.5	100.0
SE Percent		0.8	1.7	1.9	2.6	1.3	0.3	0.3	0.7	0.0
Total Return	0	181	904	1,063	4,726	475	23	23	113	7,507
SE Total Return		62	131	141	195	98	22	22	49	0
Mean Length		398	660	779	911	941	710	840	918	852 [c]
SE Mean Length		8	9	10	4	16			20	7
Minimum Length		360	555	615	680	805	710	840	850	360
Maximum Length		435	785	880	1,060	1,090	710	840	970	1,090

[a] Includes 17 fish for which age was not estimated.

[b] Includes 16 fish for which age was not estimated.

[c] Includes 33 fish for which age was not estimated and one fish for which sex was not recorded.

Table 12.-Age and sex composition estimates for the total return of chinook salmon to Chignik River and Lagoon, 1996. (Samples taken from commercial purse seine harvest in Chignik Lagoon.)

	Age									
	0.4	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	Total
Females										
Sample Size	0	0	2	14	38	7	0	1	0	62
Percent			1.9	13.3	36.2	6.7		1.0		59.0
SE Percent			1.3	3.3	4.7	2.4		0.9		4.8
Total Return	0	0	96	675	1,833	338	0	48	0	2,990
SE Total Return			67	167	236	123		48		242
Mean Length			685	822	873	902		840		862 [a]
SE Mean Length			5	18	9	16				8
Minimum Length			680	642	670	856		840		642
Maximum Length			690	900	960	980		840		980
Males										
Sample Size	0	0	7	12	17	6	0	0	1	43
Percent			6.7	11.4	16.2	5.7			1.0	41.0
SE Percent			2.4	3.1	3.6	2.3			0.9	4.8
Total Return	0	0	338	579	820	289	0	0	48	2,074
SE Total Return			123	156	181	114			48	242
Mean Length			651	781	906	960			490	836 [b]
SE Mean Length			46	37	25	26				22
Minimum Length			389	545	690	870			490	389
Maximum Length			750	923	1,090	1,030			490	1,090
All										
Sample Size	0	0	9	26	55	13	0	1	1	105
Percent			8.6	24.8	52.4	12.4		1.0	1.0	100.0
SE Percent			2.7	4.2	4.8	3.2		0.9	0.9	0.0
Total Return	0	0	434	1,254	2,653	627	0	48	48	5,064
SE Total Return			138	212	245	162		48	48	0
Mean Length			659	804	884	929		840	490	852 [c]
SE Mean Length			36	19	10	16				10
Minimum Length			389	545	670	856		840	490	389
Maximum Length			750	923	1,090	1,030		840	490	1,090

[a] Includes 11 fish for which age was not estimated.

[b] Includes 5 fish for which age was not estimated.

[c] Includes 16 fish for which age was not estimated.

DISCUSSION

The primary objective of this project is to estimate the age and sex composition of the chinook salmon returns to the Karluk, Ayakulik, and Chignik rivers, so that we can refine escapement goals through the construction of brood tables. Brood table construction has begun for the Karluk and Ayakulik rivers, Tables 13 and 14, respectively. These tables, which will be updated each year, will eventually show the total return by age class for each respective brood year. To accomplish this goal, we need to sample age and sex of chinook salmon returning to each river and estimate the number of spawners in each river each year.

Weir counts on the Karluk and Ayakulik rivers are obtained by visually counting all fish, and represent the actual number of fish which migrated upstream, unlike estimates made using other enumeration methods such as aerial surveys or sonar counts. Having an actual number for a major component of the return will help in achieving an accurate estimate of the total return. However, weir escapements represent only a portion of the Karluk and Ayakulik returns, because a mixed-stock commercial fishery harvests chinook salmon bound for the Karluk and Ayakulik rivers as well. Immature, or feeder, chinook salmon of unknown origin are also harvested in this mixed-stock fishery which occurs along the west side of Kodiak Island in June and early July. The unknown contribution of chinook salmon bound for the Karluk and Ayakulik rivers to the commercial harvest, in numbers of fish and by age and sex, adds a source of error in determining the size and biological characteristics of total returns. However, the Kodiak area commercial and marine sport harvests of chinook salmon will be sampled for coded wire tags (CWT) during the summer of 1997, in conjunction with research which is occurring in Cook Inlet. In addition to determining the magnitude of Kodiak harvests of marked stocks, CWT sampling will allow us to account for the portion of the harvest bound for locations outside the Kodiak area where CWTs were applied to chinook salmon smolt. This will remove a source of error and will improve the accuracy of return reconstruction and escapement goals.

On the Karluk River, inriver return was 12,657 and 10,051 chinook salmon in 1995 and 1996, (Table 1), while the commercial harvest was 7,023 and 9,332 chinook salmon. Clearly, the inriver return represents the largest component of the total Karluk River return because the inriver return was larger than the entire mixed-stock fishery both in 1995 and 1996. This is also true for the Ayakulik River, where over the past 10 years inriver returns have exceeded the entire mixed-stock commercial harvest eight times. We need to determine whether sampling the largest component of the return without sampling minor components will allow construction of brood tables that will be accurate enough to develop effective escapement goals.

The commercial harvest in the entire Kodiak area was monitored for CWTs in 1994. Hatchery contribution (mainly from British Columbia) accounted for about 30% of the commercial chinook salmon harvest. Subtracting fish of known origin from the mixed-stock fishery harvest will reduce bias in estimating the commercial harvest of chinook salmon returning to the Karluk and Ayakulik rivers. Knowing the age, sex, and size characteristics of the harvest may also allow for more accurate estimation of the return to each river.

In addition to establishing a sampling program to define the age and brood-year composition of the return, we also need to determine the number of fish that actually spawn. This is a crucial element because the main goal of this project is to evaluate the returns produced by different

Table 13.-Karluk River chinook salmon return by brood year, by age class, 1988-1996.

Brood Year	Inriver Return	Sport Harvest[a]	Spawning Escapement[b]	Spawning Escapement Sex Ratio		Age Classes					Total Return	Commercial Harvest[c]
				Males	Females	1.1	1.2	2.2 1.3	2.3 1.4	2.4 1.5		
1988	13,337	819	12,518			unknown	unknown	4,229	7,144	1,297	14,321	11,550
1989	10,484	559	9,925			unknown	1,107	2,339	7,553	783	12,032	9,080
1990	14,442	700	13,742			63	1,187	1,766	5,104			4,462
1991	14,022	1,599	12,423			458	1,653	2,360				
1992	9,601	856	8,745			388	1,648					
1993	13,944	1,634	12,310	5,712	6,598	99						
1994	12,049	1,483	10,566	5,505	5,061							
1995	12,657	1,284	11,373	7,002	4,371							
1996	10,051	769	9,282	444	325							

[a] From Mills 1989-1994; Howe et al. 1995-1997.

[b] Spawning escapement = Inriver Return - Sport Harvest; does not include hook-and-release mortalities.

[c] Represents the commercial harvest from Rocky Point (254-10), Outer Karluk (255-20), and Inner Karluk (255-10) from 1 June-15 July during the 2 years when 1.3 and 1.4 aged fish from the brood year would have been present in the harvest.

Table 14.-Ayakulik River chinook salmon return by brood year, by age class, 1988-1996.

Brood Year	Inriver Return	Sport Harvest[a]	Spawning Escapement[b]	Spawning Escapement Sex Ratio		Age Classes					Total Return	Commercial Harvest[c]
				Males	Females	1.1	1.2	0.4,2.2 1.3	2.3 1.4	2.4 1.5		
1988	21,370	600	20,770			unknown	unknown	1,348	4,767	1,353	10,096	3,370
1989	15,432	390	15,042			unknown	2,122	2,239	10,633	411	15,995	2,673
1990	11,251	252	10,999			51	974	2,320	4,482			5,434
1991	12,988	563	12,425			988	2,481	2,464				
1992	9,135	776	8,359			915	2,576					
1993	7,819	1,004	6,815	4,723	2,092	411						
1994	9,138	948	8,190	5,086	3,104							
1995	17,701	200	17,501	11,053	6,448							
1996	10,344	203	10,141	132	71							

[a] From Mills 1989-1994; Howe et al. 1995-1997.

[b] Spawning escapement = Inriver Return - Sport Harvest; does not include hook-and-release mortalities.

[c] Represents the commercial harvest from Halibut Bay (256-30), Gurney Bay (256-25), Inner Ayakulik (256-10), and Outer Ayakulik (256-20) from 1 June-15 July during the 2 years when 1.3 and 1.4 aged fish from the brood year would have been present in the harvest.

spawning escapements. Spawning escapement is calculated by subtracting the sport harvest and hook-and-release mortality above the weir from the inriver return at the weir.

The creel surveys which were conducted on the Karluk and Ayakulik rivers in 1993 and 1994 were discontinued in 1995 and 1996 and are not planned for the immediate future because the creel surveys were very close to the SWHS estimates.

Virtually all of the sport harvest at the Ayakulik River and most of the sport harvest at the Karluk River occurs above the weir. Therefore, spawning escapements in the future should be estimated by subtracting SWHS estimates from the weir counts. There are two problems associated with this method: mortality associated with released fish, and the SWHS estimate for the Karluk River includes harvest which occurs in the Lagoon before these fish are counted through the weir.

The SWHS estimated 2,613 sport-caught chinook salmon were released in the Karluk River in 1995 (Howe et al. 1996). Some of these fish died due to wounds received from hooks or from handling. Research on the Kenai River indicated that about 7% of released chinook salmon died due to hooking or handling after being released (Bendock and Alexandersdottir 1992). If a 7% mortality rate is applied to the release estimates for the Karluk River, then 183 less fish would have spawned in 1995. The loss to hook-and-release mortality is probably very small relative to the total return. Research to define the specific mortality rate in the Karluk River is not warranted. Applying existing estimates from the Kenai River to spawning escapement estimates for the Karluk River would adequately address this mortality factor.

Subtracting the SWHS harvest estimates for Karluk River and Lagoon from the weir count to estimate spawning escapement also introduces some bias because some of the sport harvest occurs in the Lagoon before the fish are counted at the weir. Creel surveys were conducted in 1993 and 1994, but because it is not cost effective to continue doing creel surveys in the Lagoon to adjust the spawning escapement by as little as 100 to 200 fish, and bias introduced by such a small harvest is insignificant in comparison to the size of the inriver return, these surveys were discontinued in 1995.

Although the SWHS of 1993 and 1994 accurately estimated the chinook salmon harvests, the 1995 SWHS estimate was 200 chinook salmon harvested for the entire Ayakulik River, but a harvest of 296 chinook salmon was censused at the weir and lodge. This does not take into account the harvest of chinook salmon from Bare Creek, which typically is close to 50% of the annual harvest. With this in mind, the estimated harvest of chinook salmon on the Ayakulik River in 1995 is closer to 600 fish. This difference of 400 fish between the SWHS and the weir census is not significant enough to continue spending thousands of dollars performing creel surveys.

In the summer of 1996, the only wheel-equipped airplane scheduled to pick up rafters on the beach had an accident on its first scheduled pick-up, taking the airplane out of commission for the remaining fishery. As a result, rafters scheduled to float the Ayakulik River for chinook salmon were taken to the Karluk River instead. Only five groups of rafters came through the Ayakulik River weir, where as many as 20-25 groups are common.

For Chignik River chinook salmon, the return is calculated by adding the Chignik River weir count to the commercial chinook salmon harvest from Chignik Lagoon. Chignik Lagoon is

considered a terminal harvest area because of its geographical features, and the problems associated with estimating harvest in a mixed-stock fishery do not occur here. However, at least two problems are associated with calculating the total return: some of the chinook salmon entering the Chignik River hold in the lower river and are never counted at the weir, and a mixed-stock commercial fishery in fishing districts outside of Chignik Lagoon might harvest chinook salmon of Chignik River origin.

The Chignik River weir is located about 3 miles upriver from the bay. The entire river is about 7 miles long. Some chinook salmon never go through the weir; they hold and spawn in the lower river. These fish cannot be counted from the air because the water is too deep and murky. One guess, based on sport fishing success and the number of chinook salmon that can be seen when skiffing over certain sections of the lower river, is that about 75% of chinook salmon entering the river pass through the weir and are counted, but the number of chinook salmon that hold in the lower river changes greatly from year to year (Dave Owen, Chignik Area Management Biologist, ADF&G, Kodiak, personal communication). As with the Karluk and Ayakulik rivers, we need to evaluate if the weir count and the terminal harvest in Chignik Lagoon represent a large enough percentage of the total return to develop accurate brood tables. If we determine that it is advantageous to increase the accuracy of our total return estimate then we should consider attempting to estimate the number of chinook salmon that do not pass through the weir.

The commercial harvest of chinook salmon in the districts outside of Chignik Lagoon must also be addressed. These fisheries harvest fish of mixed origin. The only chinook salmon system on the Alaska Peninsula from Unimak Island to Cape Douglas, a distance of over 500 miles, is the Chignik River, which has averaged a weir count of 4,000 fish since 1990. The average commercial harvest for this same area and time period was 23,000 chinook salmon. Because these geographic areas are known migratory routes for salmon, the percentage of Chignik-bound chinook salmon harvested in these areas is probably small. If it is necessary to research the stock composition of this harvest further several things can be done. Simply comparing average weights of chinook salmon from Chignik Lagoon with the outside districts may show that the outside harvest is made up predominantly of immature or feeder chinook salmon of nonlocal origin. A sampling program to look for CWTs and document age composition, as described for the Kodiak Management Area, could also be conducted.

RECOMMENDATIONS

To construct brood tables and evaluate returns produced by spawning escapements, we need to continue to sample inriver returns for size, sex, and age composition.

The CWT sampling program, starting in the spring of 1997, will allow us to account for a portion of the commercial harvest of non-Kodiak area origin, removing a source of error and improving the accuracy of return reconstruction and resulting escapement goals. We must evaluate the results of the CWT program and then decide if additional research is needed in order to determine stock composition and biological characteristics of the mixed-stock commercial harvest needed to produce accurate total return brood tables.

Because estimates of harvest from the 1993 and 1994 onsite creel surveys and census agreed closely with the SWHS, creel surveys in 1995 and 1996 were not necessary to accurately

estimate spawning escapement. Spawning escapement can be estimated by subtracting the SWHS estimate of harvest from the weir counts.

Although not a problem up to now, quality control during sampling should be maintained so that accurate data can be obtained. It is especially important that technicians sampling inriver returns at the weir traps are trained to accurately identify the sex of sampled fish. Additionally, crews sampling the commercial purse seine catch from Chignik Lagoon should continue to work closely with cannery personnel to insure that no chinook salmon caught outside of Chignik Lagoon are sampled.

ACKNOWLEDGMENTS

The author would like to acknowledge ADF&G field crew leaders at Chignik, Dave Owen and Dave Sarafin; at the Karluk River weir, Bob Begich, and at the Ayakulik weir Shawna Rudio and Donna Higginbotham, for collecting data that made this report possible. Steve Hammarstrom and Patti Berkhahn helped confirm author's scale aging. Biometric support and data analysis were provided by Steve Fleischman and Sandy Sonnichsen. Len Schwarz also provided many valuable comments and suggestions.

LITERATURE CITED

Bendock, T. and M. Alexandersdottir. 1992. Mortality and movement behavior of hooked-and-released chinook salmon in the Kenai River recreational fishery, 1989-1991. Alaska Department of Fish and Game, Fishery Manuscript No. 92-2, Anchorage.

Brodie, Joan R. 1996. Kodiak management area salmon escapement cumulative counts for fish-weirs, 1987-1996. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report No. 4K96-51, Kodiak.

Cochran, W. G. 1977. Sampling techniques, third edition. John Wiley and Sons, Inc. New York.

Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Association. 55:708-713.

Handler, R. and T. Chatto. *Unpublished.* A habitat analysis to determine the optimum number of Ayakulik River chinook spawners needed for escapement. United States Fish and Wildlife Service, Kodiak, Alaska.

Howe, Allen L., Gary Fidler, Allen E. Bingham, and Michael J. Mills. 1996. Harvest, catch, and participation in Alaska sport fisheries during 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-32, Anchorage.

Howe, Allen L., Gary Fidler, and Michael J. Mills. 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-24, Anchorage.

Howe, Allen L., Gary Fidler, Cynthia Olnes, Allen E. Bingham, and Michael J. Mills. 1997. Harvest, catch, and participation in Alaska sport fisheries during 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-29, Anchorage.

Mills, M. J. 1988. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 52, Juneau.

Mills, M. J. 1989. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series No. 122, Juneau.

Mills, M. J. 1990. Harvest and participation in Alaska sport fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44, Anchorage.

LITERATURE CITED (Continued)

Mills, M. J. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage.

Mills, M. J. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-40, Anchorage.

Mills, M. J. 1993. Harvest, catch, and participation in Alaska sport fisheries during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42, Anchorage.

Mills, M. J. 1994. Harvest, catch, and participation in Alaska sport fisheries during 1993. Alaska Department of Fish and Game. Fishery Data Series No. 94-28, Anchorage.

Mosher, K. H. 1969. Identification of Pacific salmon and steelhead trout by scale characteristics. United States Department of the Interior, United States Fish and Wildlife Service, Bureau of Commercial Fisheries, Circular 317, Washington, D. C.

Owen, D. L. 1993. An analysis of two counting methods used for estimates during the first hour for chinook and sockeye escapements through the Chignik weir, 1992. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 4K93-22.

Owen, D. L., A. Quimby. 1997. Chignik management area annual finfish management report, 1994. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report No. 4K97-18, Kodiak.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada 191:382.

Schwarz, L. J. 1990. Sport effort for and harvest of chinook salmon in the Chignik River, Alaska, during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-31, Anchorage.

Schwarz, L. J. 1996. Age composition and spawning escapement of chinook salmon in the Karluk, Ayakulik, and Chignik rivers, Alaska, 1993 and 1994. Alaska Department of Fish and Game, Fishery Data Series No. 96-6, Anchorage.

Welander, A. D. 1940. A study of the development of the scale of the chinook salmon (Oncorhynchus tshawytscha). Master's thesis, University of Washington, Seattle.

APPENDIX A. COMMERCIAL HARVEST OF CHINOOK SALMON FROM THE WEST SIDE OF KODIAK ISLAND BY STATISTICAL AREA, 1987-1996

Appendix A1.-Commercial harvests of chinook salmon (numbers of fish) from the west side of Kodiak Island by statistical area, 1 June through 15 July, 1987-1996.

Statistical Area	1987	1988	1989[a]	1990	1991	1992	1993	1994	1995	1996
253-11 (Uganik)	14	97	0	147	34	756	592	565	267	325
254-40 (Spiridon)	20	173	0	120	94	556	929	902	415	588
254-30 (Zachar)	24	173	0	299	57	61	749	143	701	798
254-10 (Rocky Point)	325	429	0	160	331	1,011	1,587	1,767	405	462
255-20 (Outer Karluk)	122	3	0	0	0	207	1,957	1,482	1,312	1,319
255-10 (Inner Karluk)	192	0	0	0	0	57	1,125	3,632	482	482
256-40 (Sturgeon)	28	74	0	22	1	39	0	0	153	153
256-30 (Halibut Bay)	22	838	0	0	22	155	348	0	196	224
256-25 (Gurney Bay)	60	92	0	15	206	261	283	0	65	71
256-20 (N. Ayakulik)	729	2,257	0	5,332	4,685	4,909	2,715	0	2,367	2,398
256-10 (S. Ayakulik)	0	300	0	72	103	5	24	0	45	68
257-10 (Sukhoi)	0	0	0	4	1	1	1	43	3	3
257-20 (Tannerhead)	18	357	0	362	526	659	1,365	1,433	612	649
Total number of fish	1,554	4,794	0	6,533	6,060	8,677	11,675	9,967	7,023	7,540
Average Weight (lb)	16	17		15	17	16	13	15	15	15

Source: Commercial catch numbers extracted from ADF&G, CFMD Statewide Harvest Receipt (fish ticket) database.

[a] There was no commercial harvest in 1989 due to the *Exxon Valdez* oil spill.

APPENDIX B. KARLUK RIVER CHINOOK SALMON WEIR COUNTS, 1987-1996

Appendix B1.-Daily immigration of chinook salmon through the Karluk River weir, 1987-1996.

	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1987-96
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Avg %
20-May	3	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	33	0.3	41	0.3	0	0.0	0.1
21-May	13	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	45	0.4	45	0.4	0	0.0	0.1
22-May	21	0.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	65	0.5	58	0.5	0	0.0	0.1
23-May	31	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	128	1.1	103	0.8	0	0.0	0.2
24-May	74	0.9	0	0.0	4	0.0	0	0.0	0	0.0	0	0.0	0	0.0	142	1.2	160	1.3	12	0.1	0.4
25-May	122	1.5	0	0.0	12	0.1	0	0.0	0	0.0	0	0.0	56	0.4	223	1.9	166	1.3	14	0.1	0.5
26-May	145	1.8	5	0.0	30	0.3	0	0.0	5	0.0	0	0.0	96	0.7	267	2.2	238	1.9	29	0.3	0.7
27-May	181	2.3	26	0.2	62	0.6	0	0.0	126	0.9	1	0.0	212	1.5	331	2.7	260	2.1	49	0.5	1.1
28-May	258	3.3	27	0.2	87	0.8	0	0.0	202	1.4	28	0.3	320	2.3	405	3.4	318	2.5	179	1.8	1.6
29-May	287	3.6	41	0.3	130	1.2	42	0.3	301	2.1	63	0.7	438	3.1	489	4.1	328	2.6	274	2.7	2.1
30-May	347	4.4	89	0.7	165	1.6	278	1.9	386	2.8	89	0.9	714	5.1	540	4.5	366	2.9	399	4.0	2.9
31-May	394	5.0	105	0.8	210	2.0	537	3.7	478	3.4	183	1.9	971	7.0	635	5.3	405	3.2	502	5.0	3.7
1-Jun	419	5.3	157	1.2	305	2.9	646	4.5	570	4.1	270	2.8	1,517	10.9	743	6.2	529	4.2	679	6.8	4.9
2-Jun	515	6.5	276	2.1	451	4.3	1,090	7.5	700	5.0	405	4.2	1,943	13.9	855	7.1	754	6.0	779	7.8	6.4
3-Jun	638	8.0	319	2.4	524	5.0	1311	9.1	1310	9.3	529	5.5	2,233	16.0	1204	10.0	907	7.2	1,006	10.0	8.3
4-Jun	730	9.2	409	3.1	580	5.5	1586	11.0	1545	11.0	601	6.3	2,559	18.4	1459	12.1	1,094	8.6	1,180	11.7	9.7
5-Jun	813	10.3	521	3.9	824	7.9	1,943	13.5	1,879	13.4	818	8.5	3,206	23.0	1,835	15.2	1,290	10.2	1,457	14.5	12.0
6-Jun	1,075	13.6	641	4.8	978	9.3	2,429	16.8	2,199	15.7	985	10.3	3,405	24.4	2,000	16.6	1,491	11.8	1,713	17.0	14.0
7-Jun	1,186	15.0	761	5.7	1,241	11.8	2,969	20.6	2,675	19.1	1,148	12.0	3,852	27.6	2,206	18.3	1,587	12.5	1,994	19.8	16.2
8-Jun	1,259	15.9	818	6.1	1,419	13.5	3,433	23.8	3,119	22.2	1,365	14.2	4,453	31.9	2,614	21.7	1,966	15.5	2,174	21.6	18.7
9-Jun	1,432	18.1	1,107	8.3	1,705	16.3	4,456	30.9	3,744	26.7	1,699	17.7	4,917	35.3	2,869	23.8	2,305	18.2	2,402	23.9	21.9
10-Jun	1,476	18.6	1,655	12.4	1,976	18.8	5,432	37.6	3,967	28.3	1,947	20.3	5,399	38.7	3,114	25.8	2,785	22.0	2,612	26.0	24.9
11-Jun	1,660	20.9	2,139	16.0	2,299	21.9	5,810	40.2	4,318	30.8	2,329	24.3	5,833	41.8	3,467	28.8	3,091	24.4	2,755	27.4	27.7
12-Jun	1,841	23.2	2,369	17.8	2,555	24.4	6,631	45.9	5,160	36.8	2,857	29.8	6,187	44.4	4,198	34.8	3,534	27.9	2,985	29.7	31.5
13-Jun	1,963	24.8	3,106	23.3	2,954	28.2	6,825	47.3	5,627	40.1	3,259	33.9	6,705	48.1	4,709	39.1	4,058	32.1	3,242	32.3	34.9
14-Jun	2,402	30.3	3,608	27.1	3,277	31.3	7,321	50.7	5,935	42.3	3,705	38.6	7,161	51.4	5,245	43.5	4,339	34.3	4,189	41.7	39.1
15-Jun	2,581	32.5	4,141	31.0	3,591	34.3	7,598	52.6	6,350	45.3	4,093	42.6	7,411	53.1	5,774	47.9	4,885	38.6	4,419	44.0	42.2
16-Jun	2,749	34.7	5,158	38.7	4,058	38.7	7,919	54.8	6,893	49.2	4,527	47.2	7,542	54.1	6,304	52.3	5,174	40.9	4,854	48.3	45.9

-continued-

Appendix B1.-Page 2 of 4.

	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1987-96
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Avg %
17-Jun	2,832	35.7	5,663	42.5	4,471	42.6	8,070	55.9	7,187	51.3	4,893	51.0	7,995	57.3	6,645	55.1	5,662	44.7	5,036	50.1	48.6
18-Jun	3,110	39.2	6,277	47.1	5,071	48.4	8,361	57.9	7,916	56.5	5,233	54.5	8,290	59.5	6,971	57.9	6,049	47.8	5,191	51.6	52.0
19-Jun	3,674	46.3	6,869	51.5	5,477	52.2	8,949	62.0	8,449	60.3	5,609	58.4	8,935	64.1	7,143	59.3	6,495	51.3	5,465	54.4	56.0
20-Jun	3,882	49.0	7,434	55.7	5,649	53.9	9,576	66.3	8,769	62.5	5,988	62.4	9,250	66.3	7,464	61.9	6,970	55.1	5,580	55.5	58.9
21-Jun	4,285	54.0	7,743	58.1	6,145	58.6	10,183	70.5	9,313	66.4	5,274	54.9	9,568	68.6	7,816	64.9	7,589	60.0	6,024	59.9	61.6
22-Jun	4,511	56.9	8,210	61.6	6,749	64.4	10,820	74.9	9,753	69.6	6,542	68.1	9,965	71.5	8,194	68.0	7,859	62.1	6,565	65.3	66.2
23-Jun	4,724	59.6	8,854	66.4	7,022	67.0	11,383	78.8	10,145	72.4	6,803	70.9	10,526	75.5	8,373	69.5	8,303	65.6	7,048	70.1	69.6
24-Jun	4,838	61.0	9,317	69.9	7,486	71.4	11,845	82.0	10,596	75.6	6,991	72.8	10,721	76.9	8,645	71.7	8,776	69.3	7,374	73.4	72.4
25-Jun	5,155	65.0	10,220	76.6	7,799	74.4	12,210	84.5	11,001	78.5	7,184	74.8	11,008	78.9	9,014	74.8	9,105	71.9	7,651	76.1	75.6
26-Jun	5,592	70.5	10,593	79.4	8,049	76.8	12,570	87.0	11,380	81.2	7,487	78.0	11,325	81.2	9,205	76.4	9,432	74.5	7,766	77.3	78.2
27-Jun	5,950	75.0	11,157	83.7	8,303	79.2	12,876	89.2	11,638	83.0	7,779	81.0	11,505	82.5	9,648	80.1	9,710	76.7	8,031	79.9	81.0
28-Jun	6,057	76.4	11,511	86.3	8,477	80.9	13,075	90.5	11,892	84.8	7,968	83.0	11,668	83.7	9,835	81.6	9,875	78.0	8,160	81.2	82.6
29-Jun	6,200	78.2	11,718	87.9	8,708	83.1	13,246	91.7	12,139	86.6	8,159	85.0	11,793	84.6	10,107	83.9	10,092	79.7	8,397	83.5	84.4
30-Jun	6,396	80.7	11,908	89.3	9,061	86.4	13,399	92.8	12,370	88.2	8,332	86.8	11,978	85.9	10,344	85.8	10,251	81.0	8,671	86.3	86.3
1-Jul	6,549	82.6	12,063	90.4	9,260	88.3	13,579	94.0	12,560	89.6	8,475	88.3	12,184	87.4	10,427	86.5	10,672	84.3	8,696	86.5	87.8
2-Jul	6,759	85.2	12,219	91.6	9,293	88.6	13,651	94.5	12,743	90.9	8,583	89.4	12,569	90.1	10,533	87.4	10,920	86.3	8,713	86.7	89.1
3-Jul	6,876	86.7	12,284	92.1	9,420	89.9	13,743	95.2	12,860	91.7	8,658	90.2	12,708	91.1	10,631	88.2	11,082	87.6	8,735	86.9	90.0
4-Jul	7,006	88.3	12,321	92.4	9,511	90.7	13,808	95.6	12,962	92.4	8,744	91.1	12,845	92.1	10,767	89.4	11,265	89.0	8,791	87.5	90.9
5-Jul	7,088	89.4	12,466	93.5	9,616	91.7	13,867	96.0	13,127	93.6	8,810	91.8	12,925	92.7	10,829	89.9	11,350	89.7	8,809	87.6	91.6
6-Jul	7,172	90.4	12,590	94.4	9,764	93.1	13,934	96.5	13,267	94.6	8,853	92.2	13,039	93.5	10,876	90.3	11,419	90.2	8,817	87.7	92.3
7-Jul	7,258	91.5	12,668	95.0	9,818	93.6	13,966	96.7	13,323	95.0	8,929	93.0	13,146	94.3	10,923	90.7	11,509	90.9	8,818	87.7	92.8
8-Jul	7,345	92.6	12,686	95.1	9,838	93.8	14,025	97.1	13,390	95.5	8,977	93.5	13,191	94.6	11,046	91.7	11,643	92.0	8,828	87.8	93.4
9-Jul	7,434	93.7	12,762	95.7	9,872	94.2	14,033	97.2	13,434	95.8	8,996	93.7	13,248	95.0	11,078	91.9	11,686	92.3	8,836	87.9	93.7
10-Jul	7,499	94.6	12,841	96.3	9,904	94.5	14,044	97.2	13,484	96.2	9,023	94.0	13,302	95.4	11,138	92.4	11,839	93.5	8,842	88.0	94.2
11-Jul	7,547	95.2	12,873	96.5	9,955	95.0	14,069	97.4	13,546	96.6	9,094	94.7	13,359	95.8	11,189	92.9	11,915	94.1	8,844	88.0	94.6
12-Jul	7,570	95.5	12,875	96.5	10,023	95.6	14,074	97.5	13,619	97.1	9,129	95.1	13,385	96.0	11,230	93.2	11,955	94.5	8,859	88.1	94.9
13-Jul	7,609	96.0	12,933	97.0	10,045	95.8	14,081	97.5	13,646	97.3	9,141	95.2	13,408	96.2	11,276	93.6	12,006	94.9	8,860	88.2	95.2
14-Jul	7,632	96.2	12,969	97.2	10,081	96.2	14,107	97.7	13,692	97.6	9,181	95.6	13,470	96.6	11,301	93.8	12,072	95.4	8,862	88.2	95.5
15-Jul	7,650	96.5	13,004	97.5	10,113	96.5	14,112	97.7	13,714	97.8	9,201	95.8	13,495	96.8	11,327	94.0	12,111	95.7	8,864	88.2	95.6
16-Jul	7,691	97.0	13,040	97.8	10,145	96.8	14,130	97.8	13,733	97.9	9,215	96.0	13,532	97.0	11,347	94.2	12,144	95.9	8,880	88.3	95.9

-continued-

Appendix B1.-Page 3 of 4.

	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1987-96
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Avg %
17-Jul	7,706	97.2	13,061	97.9	10,168	97.0	14,145	97.9	13,746	98.0	9,241	96.3	13,547	97.2	11,355	94.2	12,183	96.3	8,904	88.6	96.1
18-Jul	7,723	97.4	13,078	98.1	10,185	97.1	14,158	98.0	13,765	98.2	9,275	96.6	13,589	97.5	11,357	94.3	12,204	96.4	8,930	88.8	96.2
19-Jul	7,739	97.6	13,104	98.3	10,207	97.4	14,175	98.2	13,775	98.2	9,294	96.8	13,607	97.6	11,365	94.3	12,211	96.5	8,944	89.0	96.4
20-Jul	7,755	97.8	13,123	98.4	10,215	97.4	14,203	98.3	13,785	98.3	9,309	97.0	13,623	97.7	11,367	94.3	12,239	96.7	9,357	93.1	96.9
21-Jul	7,773	98.0	13,135	98.5	10,236	97.6	14,212	98.4	13,800	98.4	9,318	97.1	13,648	97.9	11,420	94.8	12,266	96.9	9,383	93.4	97.1
22-Jul	7,787	98.2	13,154	98.6	10,242	97.7	14,222	98.5	13,810	98.5	9,335	97.2	13,694	98.2	11,472	95.2	12,285	97.1	9,515	94.7	97.4
23-Jul	7,799	98.3	13,160	98.7	10,261	97.9	14,240	98.6	13,820	98.6	9,341	97.3	13,728	98.5	11,538	95.8	12,298	97.2	9,602	95.5	97.6
24-Jul	7,810	98.5	13,167	98.7	10,278	98.0	14,253	98.7	13,825	98.6	9,350	97.4	13,736	98.5	11,623	96.5	12,314	97.3	9,608	95.6	97.8
25-Jul	7,819	98.6	13,175	98.8	10,280	98.1	14,263	98.8	13,837	98.7	9,360	97.5	13,759	98.7	11,687	97.0	12,345	97.5	9,638	95.9	97.9
26-Jul	7,826	98.7	13,185	98.9	10,280	98.1	14,281	98.9	13,849	98.8	9,371	97.6	13,765	98.7	11,697	97.1	12,375	97.8	9,650	96.0	98.0
27-Jul	7,837	98.8	13,193	98.9	10,288	98.1	14,291	99.0	13,870	98.9	9,394	97.8	13,768	98.7	11,728	97.3	12,393	97.9	9,656	96.1	98.2
28-Jul	7,844	98.9	13,197	99.0	10,292	98.2	14,297	99.0	13,879	99.0	9,404	97.9	13,776	98.8	11,770	97.7	12,418	98.1	9,755	97.1	98.4
29-Jul	7,848	99.0	13,219	99.1	10,298	98.2	14,305	99.1	13,889	99.1	9,433	98.3	13,788	98.9	11,777	97.7	12,472	98.5	9,796	97.5	98.5
30-Jul	7,862	99.1	13,223	99.1	10,309	98.3	14,309	99.1	13,899	99.1	9,450	98.4	13,789	98.9	11,797	97.9	12,481	98.6	9,801	97.5	98.6
31-Jul	7,865	99.2	13,228	99.2	10,315	98.4	14,312	99.1	13,919	99.3	9,480	98.7	13,803	99.0	11,814	98.0	12,485	98.6	9,850	98.0	98.8
1-Aug	7,871	99.3	13,241	99.3	10,329	98.5	14,316	99.1	13,920	99.3	9,499	98.9	13,827	99.2	11,823	98.1	12,489	98.7	9,886	98.4	98.9
2-Aug	7,873	99.3	13,247	99.3	10,336	98.6	14,323	99.2	13,935	99.4	9,510	99.1	13,830	99.2	11,826	98.1	12,492	98.7	9,895	98.4	98.9
3-Aug	7,878	99.3	13,266	99.5	10,341	98.6	14,330	99.2	13,941	99.4	9,524	99.2	13,832	99.2	11,838	98.2	12,522	98.9	9,912	98.6	99.0
4-Aug	7,884	99.4	13,267	99.5	10,351	98.7	14,348	99.3	13,947	99.5	9,528	99.2	13,838	99.2	11,862	98.4	12,528	99.0	9,926	98.8	99.1
5-Aug	7,890	99.5	13,272	99.5	10,360	98.8	14,352	99.4	13,950	99.5	9,535	99.3	13,847	99.3	11,893	98.7	12,529	99.0	9,936	98.9	99.2
6-Aug	7,894	99.5	13,273	99.5	10,372	98.9	14,364	99.5	13,957	99.5	9,542	99.4	13,860	99.4	11,901	98.8	12,532	99.0	9,944	98.9	99.2
7-Aug	7,896	99.6	13,274	99.5	10,375	99.0	14,366	99.5	13,963	99.6	9,545	99.4	13,869	99.5	11,929	99.0	12,536	99.0	9,946	99.0	99.3
8-Aug	7,900	99.6	13,279	99.6	10,378	99.0	14,372	99.5	13,969	99.6	9,545	99.4	13,871	99.5	11,979	99.4	12,546	99.1	9,950	99.0	99.4
9-Aug	7,902	99.6	13,287	99.6	10,381	99.0	14,379	99.6	13,976	99.7	9,547	99.4	13,872	99.5	11,995	99.6	12,566	99.3	9,957	99.1	99.4
10-Aug	7,908	99.7	13,293	99.7	10,393	99.1	14,383	99.6	13,983	99.7	9,549	99.5	13,878	99.5	12,007	99.7	12,588	99.5	9,963	99.1	99.5
11-Aug	7,912	99.8	13,299	99.7	10,402	99.2	14,389	99.6	13,989	99.8	9,552	99.5	13,892	99.6	12,009	99.7	12,596	99.5	9,970	99.2	99.6
12-Aug	7,915	99.8	13,303	99.7	10,403	99.2	14,396	99.7	13,991	99.8	9,556	99.5	13,896	99.7	12,017	99.7	12,618	99.7	9,976	99.3	99.6
13-Aug	7,916	99.8	13,304	99.8	10,404	99.2	14,398	99.7	13,992	99.8	9,557	99.5	13,898	99.7	12,020	99.8	12,624	99.7	9,980	99.3	99.6
14-Aug	7,918	99.8	13,308	99.8	10,407	99.3	14,398	99.7	13,995	99.8	9,559	99.6	13,902	99.7	12,023	99.8	12,631	99.8	9,982	99.3	99.7
15-Aug	7,920	99.9	13,311	99.8	10,411	99.3	14,398	99.7	13,999	99.8	9,563	99.6	13,903	99.7	12,025	99.8	12,632	99.8	9,992	99.4	99.7

-continued-

Appendix B1.-Page 4 of 4.

	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1987-96
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Avg %
16-Aug	7,923	99.9	13,312	99.8	10,413	99.3	14,399	99.7	14,000	99.8	9,575	99.7	13,911	99.8	12,027	99.8	12,632	99.8	9,996	99.5	99.7
17-Aug	7,924	99.9	13,316	99.8	10,418	99.4	14,400	99.7	14,001	99.9	9,578	99.8	13,913	99.8	12,030	99.8	12,633	99.8	9,999	99.5	99.7
18-Aug	7,924	99.9	13,317	99.9	10,429	99.5	14,400	99.7	14,002	99.9	9,578	99.8	13,919	99.8	12,032	99.9	12,634	99.8	10,000	99.5	99.8
19-Aug	7,925	99.9	13,320	99.9	10,432	99.5	14,401	99.7	14,006	99.9	9,578	99.8	13,923	99.8	12,035	99.9	12,634	99.8	10,013	99.6	99.8
20-Aug	7,925	99.9	13,324	99.9	10,436	99.5	14,403	99.7	14,008	99.9	9,580	99.8	13,928	99.9	12,036	99.9	12,634	99.8	10,019	99.7	99.8
21-Aug	7,927	99.9	13,328	99.9	10,438	99.6	14,405	99.7	14,008	99.9	9,584	99.8	13,932	99.9	12,042	99.9	12,635	99.8	10,031	99.8	99.8
22-Aug	7,927	99.9	13,329	99.9	10,446	99.6	14,409	99.8	14,008	99.9	9,585	99.8	13,934	99.9	12,042	99.9	12,636	99.8	10,033	99.8	99.9
23-Aug	7,928	99.9	13,330	99.9	10,454	99.7	14,413	99.8	14,009	99.9	9,591	99.9	13,936	99.9	12,045	99.9	12,637	99.8	10,037	99.9	99.9
24-Aug	7,929	99.9	13,331	99.9	10,458	99.8	14,415	99.8	14,010	99.9	9,594	99.9	13,938	99.9	12,046	99.9	12,639	99.9	10,039	99.9	99.9
25-Aug	7,929	99.9	13,332	99.9	10,463	99.8	14,417	99.8	14,011	99.9	9,595	99.9	13,940	99.9	12,047	99.9	12,640	99.9	10,039	99.9	99.9
26-Aug	7,929	99.9	13,332	99.9	10,464	99.8	14,422	99.9	14,013	99.9	9,596	99.9	13,940	99.9	12,049	100.0	12,641	99.9	10,041	99.9	99.9
27-Aug	7,930	100.0	13,332	99.9	10,465	99.8	14,427	99.9	14,014	99.9	9,596	99.9	13,942	99.9	12,049	100.0	12,643	99.9	10,043	99.9	99.9
28-Aug	7,930	100.0	13,332	99.9	10,468	99.8	14,428	99.9	14,015	99.9	9,596	99.9	13,943	99.9	12,049	100.0	12,650	99.9	10,043	99.9	99.9
29-Aug	7,930	100.0	13,334	99.9	10,472	99.9	14,432	99.9	14,016	99.9	9,596	99.9	13,943	99.9	12,049	100.0	12,652	99.9	10,046	99.9	99.9
30-Aug	7,930	100.0	13,336	99.9	10,473	99.9	14,432	99.9	14,016	99.9	9,596	99.9	13,943	99.9	12,049	100.0	12,654	99.9	10,046	99.9	99.9
31-Aug	7,930	100.0	13,337	100.0	10,473	99.9	14,433	99.9	14,016	99.9	9,596	99.9	13,943	99.9	12,049	100.0	12,655	99.9	10,047	99.9	99.9
1-Sep	7,930	100.0	13,337	100.0	10,475	99.9	14,436	99.9	14,020	99.9	9,596	99.9	13,943	99.9	12,049	100.0	12,656	99.9	10,050	99.9	99.9
2-Sep	7,930	100.0	13,337	100.0	10,476	99.9	14,441	99.9	14,020	99.9	9,596	99.9	13,944	100.0	12,049	100.0	12,656	99.9	10,051	100.0	100.0
Season Total	7,930		13,337		10,484		14,442		14,022		9,601		13,944		12,049		12,657		10,051		

APPENDIX C. AYAKULIK RIVER CHINOOK SALMON WEIR COUNTS, 1987-1996

Appendix C1.-Daily counts of chinook salmon through the Ayakulik River weir, 1987-1996.

	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1987-96
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Avg %
20-May	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	0.0	0	0.0	0	0.0	0.0
21-May	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	15	0.2	0	0.0	0	0.0	0.0
22-May	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	205	2.2	0	0.0	39	0.4	0	0.0	0	0.0	0.3
23-May	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	361	4.0	21	0.3	63	0.7	0	0.0	0	0.0	0.5
24-May	30	0.2	0	0.0	0	0.0	0	0.0	0	0.0	800	8.8	28	0.4	88	1.0	0	0.0	25	0.2	1.1
25-May	36	0.2	15	0.1	0	0.0	0	0.0	20	0.2	885	9.7	37	0.5	100	1.1	0	0.0	65	0.6	1.2
26-May	85	0.5	284	1.3	0	0.0	0	0.0	78	0.6	1,042	11.4	44	0.6	129	1.4	0	0.0	73	0.7	1.7
27-May	167	1.1	401	1.9	0	0.0	800	7.1	113	0.9	1,351	14.8	103	1.3	158	1.7	2	0.0	75	0.7	2.9
28-May	225	1.4	560	2.6	0	0.0	1,318	11.7	380	2.9	1,588	17.4	241	3.1	204	2.2	11	0.1	91	0.9	4.2
29-May	270	1.7	714	3.3	0	0.0	1,709	15.2	566	4.4	1,699	18.6	326	4.2	210	2.3	22	0.1	111	1.1	5.1
30-May	361	2.3	892	4.2	0	0.0	2,137	19.0	603	4.6	1,836	20.1	370	4.7	265	2.9	29	0.2	123	1.2	5.9
31-May	415	2.7	1,021	4.8	7	0.0	2,409	21.4	655	5.0	2,012	22.0	821	10.5	294	3.2	41	0.2	318	3.1	7.3
1-Jun	491	3.1	1,106	5.2	58	0.4	3,100	27.6	671	5.2	2,045	22.4	1,927	24.6	328	3.6	127	0.7	622	6.0	9.9
2-Jun	526	3.4	1,176	5.5	202	1.3	3,797	33.7	697	5.4	2,385	26.1	3,118	39.9	568	6.2	349	2.0	961	9.3	13.3
3-Jun	538	3.4	1,400	6.6	255	1.7	4,144	36.8	711	5.5	2,879	31.5	3,225	41.2	694	7.6	532	3.0	1,642	15.9	15.3
4-Jun	913	5.8	1,634	7.6	387	2.5	4,393	39.0	772	5.9	2,957	32.4	3,352	42.9	1,304	14.3	2,818	15.9	1,822	17.6	18.4
5-Jun	1,285	8.2	1,872	8.8	494	3.2	4,988	44.3	961	7.4	3,030	33.2	3,585	45.8	1,565	17.1	3,602	20.3	2,020	19.5	20.8
6-Jun	2,071	13.2	2,086	9.8	804	5.2	5,708	50.7	1,544	11.9	3,384	37.0	3,623	46.3	1,636	17.9	4,111	23.2	2,988	28.9	24.4
7-Jun	2,442	15.6	2,278	10.7	1,272	8.2	5,787	51.4	3,068	23.6	4,073	44.6	3,686	47.1	1,860	20.4	4,397	24.8	3,317	32.1	27.9
8-Jun	2,611	16.7	2,426	11.4	1,408	9.1	6,659	59.2	4,164	32.1	4,273	46.8	3,708	47.4	2,731	29.9	5,167	29.2	3,404	32.9	31.5
9-Jun	2,743	17.5	2,590	12.1	1,520	9.8	6,893	61.3	5,852	45.1	4,414	48.3	3,861	49.4	3,257	35.6	5,466	30.9	3,413	33.0	34.3
10-Jun	3,157	20.2	2,857	13.4	2,134	13.8	7,005	62.3	7,116	54.8	4,480	49.0	4,154	53.1	3,641	39.8	5,671	32.0	3,473	33.6	37.2
11-Jun	3,580	22.9	3,975	18.6	2,967	19.2	7,157	63.6	7,714	59.4	4,624	50.6	4,537	58.0	3,797	41.6	5,936	33.5	3,511	33.9	40.1
12-Jun	3,671	23.5	5,045	23.6	4,073	26.4	7,216	64.1	8,268	63.7	4,848	53.1	4,807	61.5	4,293	47.0	6,245	35.3	3,585	34.7	43.3
13-Jun	3,804	24.3	7,117	33.3	4,966	32.2	7,427	66.0	8,311	64.0	5,115	56.0	5,041	64.5	4,321	47.3	7,213	40.7	3,740	36.2	46.4
14-Jun	4,044	25.9	7,586	35.5	5,580	36.2	7,433	66.1	8,728	67.2	5,261	57.6	5,160	66.0	4,544	49.7	7,470	42.2	4,080	39.4	48.6
15-Jun	4,158	26.6	7,897	37.0	6,732	43.6	7,448	66.2	8,858	68.2	5,435	59.5	5,255	67.2	4,825	52.8	7,800	44.1	4,773	46.1	51.1
16-Jun	4,432	28.3	8,979	42.0	7,357	47.7	7,698	68.4	8,884	68.4	5,626	61.6	5,437	69.5	4,933	54.0	8,160	46.1	5,579	53.9	54.0

-continued-

Appendix C1.-Page 2 of 4.

	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1987-96
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Avg %
17-Jun	5,006	32.0	10,020	46.9	8,238	53.4	7,948	70.6	9,001	69.3	5,807	63.6	5,553	71.0	5,155	56.4	8,633	48.8	6,015	58.1	57.0
18-Jun	5,411	34.6	10,268	48.0	9,192	59.6	8,198	72.9	9,168	70.6	5,901	64.6	5,664	72.4	5,347	58.5	9,021	51.0	6,113	59.1	59.1
19-Jun	5,714	36.5	12,263	57.4	9,218	59.7	8,448	75.1	9,259	71.3	6,085	66.6	5,834	74.6	5,461	59.8	9,368	52.9	6,161	59.6	61.4
20-Jun	5,971	38.2	12,340	57.7	10,032	65.0	8,578	76.2	9,295	71.6	6,116	67.0	5,917	75.7	5,536	60.6	9,781	55.3	6,428	62.1	62.9
21-Jun	7,037	45.0	13,453	63.0	10,259	66.5	8,983	79.8	9,317	71.7	6,520	71.4	5,936	75.9	5,771	63.2	11,126	62.9	7,144	69.1	66.8
22-Jun	7,689	49.2	14,292	66.9	10,440	67.7	9,242	82.1	9,482	73.0	6,672	73.0	6,041	77.3	5,931	64.9	11,797	66.6	7,583	73.3	69.4
23-Jun	8,669	55.4	14,676	68.7	10,587	68.6	9,605	85.4	9,698	74.7	7,189	78.7	6,075	77.7	6,190	67.7	12,269	69.3	8,746	84.6	73.1
24-Jun	9,419	60.2	15,276	71.5	10,865	70.4	9,890	87.9	10,274	79.1	7,430	81.3	6,118	78.2	6,789	74.3	13,292	75.1	8,819	85.3	76.3
25-Jun	9,644	61.7	15,967	74.7	11,077	71.8	10,095	89.7	10,614	81.7	7,527	82.4	6,490	83.0	7,229	79.1	14,207	80.3	8,915	86.2	79.1
26-Jun	10,019	64.1	16,323	76.4	11,836	76.7	10,137	90.1	10,754	82.8	7,667	83.9	6,732	86.1	7,724	84.5	14,618	82.6	9,010	87.1	81.4
27-Jun	11,071	70.8	17,161	80.3	12,084	78.3	10,180	90.5	10,815	83.3	7,800	85.4	6,778	86.7	7,906	86.5	15,177	85.7	9,083	87.8	83.5
28-Jun	11,441	73.2	17,640	82.5	12,347	80.0	10,202	90.7	11,419	87.9	7,933	86.8	6,872	87.9	7,990	87.4	15,557	87.9	9,269	89.6	85.4
29-Jun	11,674	74.7	18,038	84.4	13,192	85.5	10,400	92.4	11,916	91.7	8,067	88.3	6,908	88.3	8,093	88.6	15,702	88.7	9,434	91.2	87.4
30-Jun	12,071	77.2	18,522	86.7	13,312	86.3	10,561	93.9	12,039	92.7	8,153	89.3	6,947	88.8	8,261	90.4	16,291	92.0	9,557	92.4	89.0
1-Jul	12,409	79.4	18,886	88.4	13,396	86.8	10,656	94.7	12,122	93.3	8,221	90.0	6,960	89.0	8,443	92.4	16,446	92.9	9,582	92.6	90.0
2-Jul	12,769	81.7	19,212	89.9	13,430	87.0	10,739	95.4	12,338	95.0	8,285	90.7	7,186	91.9	8,522	93.3	16,676	94.2	9,642	93.2	91.2
3-Jul	13,695	87.6	19,277	90.2	13,651	88.5	10,809	96.1	12,370	95.2	8,395	91.9	7,234	92.5	8,619	94.3	16,771	94.7	9,750	94.3	92.5
4-Jul	14,375	91.9	19,370	90.6	13,815	89.5	10,821	96.2	12,465	96.0	8,474	92.8	7,266	92.9	8,661	94.8	16,810	95.0	9,809	94.8	93.5
5-Jul	14,592	93.3	19,398	90.8	14,148	91.7	10,834	96.3	12,514	96.4	8,503	93.1	7,288	93.2	8,691	95.1	16,850	95.2	9,858	95.3	94.0
6-Jul	14,732	94.2	19,664	92.0	14,251	92.3	10,877	96.7	12,549	96.6	8,581	93.9	7,368	94.2	8,740	95.6	16,914	95.6	9,988	96.6	94.8
7-Jul	14,770	94.5	19,883	93.0	14,543	94.2	10,894	96.8	12,572	96.8	8,660	94.8	7,408	94.7	8,806	96.4	17,155	96.9	10,087	97.5	95.6
8-Jul	14,931	95.5	20,211	94.6	14,667	95.0	10,948	97.3	12,589	96.9	8,750	95.8	7,438	95.1	8,832	96.7	17,182	97.1	10,132	98.0	96.2
9-Jul	14,692	94.0	20,410	95.5	14,668	95.0	10,953	97.4	12,610	97.1	8,755	95.8	7,471	95.5	8,873	97.1	17,220	97.3	10,153	98.2	96.3
10-Jul	15,071	96.4	20,416	95.5	14,669	95.1	10,970	97.5	12,636	97.3	8,768	96.0	7,530	96.3	8,942	97.9	17,315	97.8	10,153	98.2	96.8
11-Jul	15,176	97.1	20,449	95.7	14,721	95.4	10,970	97.5	12,638	97.3	8,840	96.8	7,547	96.5	8,973	98.2	17,359	98.1	10,172	98.3	97.1
12-Jul	15,270	97.7	20,493	95.9	14,862	96.3	10,971	97.5	12,640	97.3	8,891	97.3	7,573	96.9	8,990	98.4	17,376	98.2	10,194	98.5	97.4
13-Jul	15,289	97.8	20,562	96.2	14,943	96.8	10,973	97.5	12,691	97.7	8,916	97.6	7,587	97.0	9,008	98.6	17,414	98.4	10,194	98.5	97.6
14-Jul	15,350	98.2	20,836	97.5	14,962	97.0	10,999	97.8	12,709	97.9	8,958	98.1	7,615	97.4	9,025	98.8	17,420	98.4	10,202	98.6	97.9
15-Jul	15,362	98.2	20,881	97.7	14,991	97.1	11,025	98.0	12,711	97.9	8,967	98.2	7,649	97.8	9,036	98.9	17,459	98.6	10,211	98.7	98.1
16-Jul	15,376	98.3	20,948	98.0	14,998	97.2	11,042	98.1	12,715	97.9	8,984	98.3	7,659	98.0	9,054	99.1	17,490	98.8	10,227	98.9	98.3

-continued-

Appendix C1.-Page 3 of 4.

	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1987-96
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Avg %
17-Jul	15,406	98.5	20,949	98.0	15,013	97.3	11,042	98.1	12,721	97.9	9,003	98.6	7,682	98.2	9,069	99.2	17,512	98.9	10,234	98.9	98.4
18-Jul	15,423	98.6	20,963	98.1	15,019	97.3	11,042	98.1	12,728	98.0	9,018	98.7	7,704	98.5	9,082	99.4	17,516	99.0	10,249	99.1	98.5
19-Jul	15,440	98.7	20,965	98.1	15,077	97.7	11,042	98.1	12,728	98.0	9,020	98.7	7,704	98.5	9,088	99.5	17,549	99.1	10,256	99.1	98.6
20-Jul	15,456	98.8	21,033	98.4	15,092	97.8	11,051	98.2	12,733	98.0	9,030	98.9	7,706	98.6	9,094	99.5	17,577	99.3	10,260	99.2	98.7
21-Jul	15,471	98.9	21,058	98.5	15,127	98.0	11,076	98.4	12,749	98.2	9,054	99.1	7,708	98.6	9,099	99.6	17,581	99.3	10,266	99.2	98.8
22-Jul	15,475	99.0	21,065	98.6	15,160	98.2	11,087	98.5	12,795	98.5	9,060	99.2	7,713	98.6	9,104	99.6	17,585	99.3	10,289	99.5	98.9
23-Jul	15,485	99.0	21,085	98.7	15,192	98.4	11,093	98.6	12,809	98.6	9,060	99.2	7,716	98.7	9,105	99.6	17,599	99.4	10,291	99.5	99.0
24-Jul	15,489	99.1	21,093	98.7	15,209	98.6	11,105	98.7	12,835	98.8	9,069	99.3	7,749	99.1	9,108	99.7	17,610	99.5	10,293	99.5	99.1
25-Jul	15,514	99.2	21,113	98.8	15,210	98.6	11,107	98.7	12,835	98.8	9,076	99.4	7,749	99.1	9,111	99.7	17,618	99.5	10,298	99.6	99.1
26-Jul	15,532	99.3	21,123	98.8	15,241	98.8	11,115	98.8	12,836	98.8	9,080	99.4	7,757	99.2	9,111	99.7	17,620	99.5	10,301	99.6	99.2
27-Jul	15,541	99.4	21,135	98.9	15,257	98.9	11,118	98.8	12,881	99.2	9,081	99.4	7,758	99.2	9,113	99.7	17,628	99.6	10,305	99.6	99.3
28-Jul	15,547	99.4	21,173	99.1	15,258	98.9	11,133	99.0	12,886	99.2	9,086	99.5	7,771	99.4	9,115	99.7	17,637	99.6	10,307	99.6	99.3
29-Jul	15,553	99.5	21,184	99.1	15,268	98.9	11,158	99.2	12,892	99.3	9,088	99.5	7,778	99.5	9,116	99.8	17,649	99.7	10,308	99.7	99.4
30-Jul	15,555	99.5	21,204	99.2	15,310	99.2	11,169	99.3	12,897	99.3	9,091	99.5	7,781	99.5	9,118	99.8	17,651	99.7	10,314	99.7	99.5
31-Jul	15,567	99.6	21,206	99.2	15,318	99.3	11,180	99.4	12,901	99.3	9,094	99.6	7,781	99.5	9,118	99.8	17,659	99.8	10,316	99.7	99.5
1-Aug	15,573	99.6	21,210	99.3	15,323	99.3	11,192	99.5	12,901	99.3	9,098	99.6	7,788	99.6	9,120	99.8	17,664	99.8	10,321	99.8	99.6
2-Aug	15,575	99.6	21,212	99.3	15,341	99.4	11,200	99.5	12,906	99.4	9,100	99.6	7,788	99.6	9,125	99.9	17,670	99.8	10,323	99.8	99.6
3-Aug	15,577	99.6	21,225	99.3	15,354	99.5	11,209	99.6	12,915	99.4	9,105	99.7	7,789	99.6	9,127	99.9	17,675	99.9	10,326	99.8	99.6
4-Aug	15,581	99.6	21,236	99.4	15,360	99.5	11,216	99.7	12,922	99.5	9,108	99.7	7,795	99.7	9,127	99.9	17,681	99.9	10,326	99.8	99.7
5-Aug	15,585	99.7	21,250	99.4	15,367	99.6	11,218	99.7	12,926	99.5	9,111	99.7	7,795	99.7	9,127	99.9	17,685	99.9	10,329	99.9	99.7
6-Aug	15,587	99.7	21,272	99.5	15,375	99.6	11,222	99.7	12,936	99.6	9,115	99.8	7,796	99.7	9,127	99.9	17,687	99.9	10,330	99.9	99.7
7-Aug	15,594	99.7	21,289	99.6	15,378	99.7	11,228	99.8	12,938	99.6	9,119	99.8	7,797	99.7	9,127	99.9	17,693	99.9	10,338	99.9	99.8
8-Aug	15,597	99.8	21,291	99.6	15,383	99.7	11,233	99.8	12,942	99.6	9,122	99.9	7,798	99.7	9,127	99.9	17,694	99.9	10,338	99.9	99.8
9-Aug	15,598	99.8	21,301	99.7	15,388	99.7	11,233	99.8	12,947	99.7	9,125	99.9	7,799	99.7	9,127	99.9	17,694	99.9	10,338	99.9	99.8
10-Aug	15,602	99.8	21,311	99.7	15,396	99.8	11,237	99.9	12,954	99.7	9,126	99.9	7,808	99.9	9,128	99.9	17,695	99.9	10,340	99.9	99.8
11-Aug	15,603	99.8	21,330	99.8	15,398	99.8	11,238	99.9	12,972	99.9	9,130	99.9	7,808	99.9	9,129	99.9	17,696	99.9	10,341	99.9	99.9
12-Aug	15,606	99.8	21,334	99.8	15,406	99.8	11,239	99.9	12,978	99.9	9,130	99.9	7,809	99.9	9,131	99.9	17,697	99.9	10,343	99.9	99.9
13-Aug	15,608	99.8	21,336	99.8	15,408	99.8	11,239	99.9	12,988	100.0	9,131	99.9	7,809	99.9	9,133	99.9	17,697	99.9	10,344	100.0	99.9
14-Aug	15,611	99.8	21,340	99.9	15,414	99.9	11,242	99.9	12,988	100.0	9,131	99.9	7,809	99.9	9,135	99.9	17,698	99.9	10,344	100.0	99.9
15-Aug	15,613	99.9	21,344	99.9	15,421	99.9	11,242	99.9	12,988	100.0	9,131	99.9	7,813	99.9	9,137	99.9	17,699	99.9	10,344	100.0	99.9

-continued-

Appendix C1.-Page 4 of 4.

	1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1987-96
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Avg %
16-Aug	15,616	99.9	21,347	99.9	15,421	99.9	11,245	99.9	12,988	100.0	9,131	99.9	7,817	99.9	9,137	99.9	17,699	99.9	10,344	100.0	99.9
17-Aug	15,618	99.9	21,356	99.9	15,425	99.9	11,246	99.9	12,988	100.0	9,134	99.9	7,818	99.9	9,137	99.9	17,700	99.9	10,344	100.0	99.9
18-Aug	15,619	99.9	21,360	99.9	15,428	99.9	11,246	99.9	12,988	100.0	9,134	99.9	7,818	99.9	9,137	99.9	17,700	99.9	10,344	100.0	99.9
19-Aug	15,626	99.9	21,364	99.9	15,429	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,818	99.9	9,137	99.9	17,700	99.9	10,344	100.0	99.9
20-Aug	15,629	99.9	21,367	99.9	15,429	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,818	99.9	9,137	99.9	17,700	99.9	10,344	100.0	99.9
21-Aug	15,629	99.9	21,368	99.9	15,430	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,818	99.9	9,137	99.9	17,701	100.0	10,344	100.0	99.9
22-Aug	15,630	99.9	21,369	99.9	15,431	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,137	99.9	17,701	100.0	10,344	100.0	100.0
23-Aug	15,631	99.9	21,369	99.9	15,431	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
24-Aug	15,632	99.9	21,370	100.0	15,431	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
25-Aug	15,633	99.9	21,370	100.0	15,431	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
26-Aug	15,636	100.0	21,370	100.0	15,431	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
27-Aug	15,636	100.0	21,370	100.0	15,431	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
28-Aug	15,636	100.0	21,370	100.0	15,431	99.9	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
29-Aug	15,636	100.0	21,370	100.0	15,432	100.0	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
30-Aug	15,636	100.0	21,370	100.0	15,432	100.0	11,249	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
31-Aug	15,636	100.0	21,370	100.0	15,432	100.0	11,250	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
1-Sep	15,636	100.0	21,370	100.0	15,432	100.0	11,250	99.9	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
2-Sep	15,636	100.0	21,370	100.0	15,432	100.0	11,251	100.0	12,988	100.0	9,135	100.0	7,819	100.0	9,138	100.0	17,701	100.0	10,344	100.0	100.0
Season Total	15,636		21,370		15,432		11,251		12,988		9,135		7,819		9,138		17,701		10,344		

APPENDIX D. CHIGNIK RIVER CHINOOK SALMON WEIR COUNTS AND CHIGNIK LAGOON COMMERCIAL HARVESTS, 1987-1996

Appendix D1.-Daily counts of chinook salmon through the Chignik River weir and daily harvests in the Chignik Lagoon commercial fishery, 1987-1996.

	1987[a,b]				1988[a,b]				1989[a,b]				1990[a,b]			
Date	Weir	Harvest	Total	%	Weir	Harvest	Total	%	Weir	Harvest	Total	%	Weir	Harvest	Total	%
20-Jun	6	22	28	0.7	0	0	0	0.0	24	26	50	0.8	0	27	27	0.3
21-Jun	6	27	33	0.8	0	0	0	0.0	24	26	50	0.8	0	27	27	0.3
22-Jun	18	27	45	1.1	12	0	12	0.1	24	26	50	0.8	0	27	27	0.3
23-Jun	18	27	45	1.1	30	0	30	0.3	54	26	80	1.2	6	27	33	0.4
24-Jun	18	48	66	1.5	30	0	30	0.3	60	26	86	1.3	30	27	57	0.7
25-Jun	18	60	78	1.8	54	0	54	0.6	63	26	89	1.4	80	149	229	2.9
26-Jun	36	65	101	2.4	210	0	210	2.4	68	26	94	1.5	170	210	380	4.9
27-Jun	162	65	227	5.3	276	0	276	3.2	74	26	100	1.6	182	210	392	5.0
28-Jun	198	65	263	6.2	300	0	300	3.4	99	26	125	2.0	230	210	440	5.7
29-Jun	228	65	293	6.9	414	0	414	4.8	183	480	663	10.4	332	210	542	7.0
30-Jun	228	106	334	7.8	510	0	510	5.9	189	480	669	10.4	386	379	765	9.8
1-Jul	252	146	398	9.3	528	0	528	6.1	260	480	740	11.6	416	540	956	12.3
2-Jul	312	226	538	12.6	570	0	570	6.5	384	480	864	13.5	434	659	1,093	14.1
3-Jul	330	264	594	13.9	600	507	1,107	12.7	576	872	1,448	22.6	456	812	1,268	16.3
4-Jul	330	292	622	14.6	690	925	1,615	18.6	612	1,198	1,810	28.3	600	908	1,508	19.4
5-Jul	348	324	672	15.8	888	1,334	2,222	25.5	654	1,198	1,852	28.9	708	1,068	1,776	22.8
6-Jul	348	383	731	17.1	1,056	1,334	2,390	27.5	714	1,198	1,912	29.9	852	1,182	2,034	26.1
7-Jul	354	477	831	19.5	1,320	1,334	2,654	30.5	763	1,504	2,267	35.4	1,008	1,324	2,332	30.0
8-Jul	450	571	1,021	23.9	1,544	1,334	2,878	33.1	781	1,654	2,435	38.0	1,302	1,480	2,782	35.8
9-Jul	510	710	1,220	28.6	2,030	1,508	3,538	40.6	877	1,654	2,531	39.5	1,980	1,607	3,587	46.1
10-Jul	780	888	1,668	39.1	2,168	2,751	4,919	56.5	1,225	1,654	2,879	44.9	2,130	1,607	3,737	48.0
11-Jul	888	888	1,776	41.6	2,474	3,260	5,734	65.9	1,297	1,654	2,951	46.1	2,274	1,607	3,881	49.9
12-Jul	1,050	888	1,938	45.4	2,648	3,537	6,185	71.1	1,399	1,654	3,053	47.7	2,502	1,607	4,109	52.8
13-Jul	1,092	1,107	2,199	51.6	2,708	3,537	6,245	71.7	1,453	2,280	3,733	58.3	2,670	1,607	4,277	55.0
14-Jul	1,188	1,115	2,303	54.0	2,870	3,537	6,407	73.6	1,609	2,280	3,889	60.7	2,808	1,937	4,745	61.0
15-Jul	1,224	1,461	2,685	63.0	3,140	3,537	6,677	76.7	1,717	2,570	4,287	66.9	2,826	2,281	5,107	65.7
16-Jul	1,248	1,637	2,885	67.6	3,200	3,556	6,756	77.6	1,813	2,570	4,383	68.4	2,886	2,393	5,279	67.9
17-Jul	1,266	1,708	2,974	69.7	3,368	3,717	7,085	81.4	1,837	2,570	4,407	68.8	2,964	2,556	5,520	71.0
18-Jul	1,309	1,792	3,101	72.7	3,488	3,801	7,289	83.7	1,921	2,570	4,491	70.1	3,162	2,692	5,854	75.3
19-Jul	1,383	1,792	3,175	74.4	3,566	3,908	7,474	85.9	2,071	2,570	4,641	72.5	3,234	2,865	6,099	78.4
20-Jul	1,569	1,792	3,361	78.8	3,680	3,985	7,665	88.1	2,199	2,570	4,769	74.5	3,324	2,978	6,302	81.0
21-Jul	1,791	1,792	3,583	84.0	3,854	4,018	7,872	90.4	2,229	2,570	4,799	74.9	3,576	3,128	6,704	86.2
22-Jul	1,935	1,792	3,727	87.4	3,956	4,018	7,974	91.6	2,291	3,018	5,309	82.9	3,876	3,128	7,004	90.0
23-Jul	2,049	1,792	3,841	90.1	4,004	4,018	8,022	92.2	2,458	3,137	5,595	87.4	3,954	3,128	7,082	91.0
24-Jul	2,151	1,792	3,943	92.5	4,040	4,060	8,100	93.1	2,542	3,137	5,679	88.7	3,996	3,128	7,124	91.6
25-Jul	2,288	1,792	4,080	95.7	4,070	4,126	8,196	94.2	2,644	3,137	5,781	90.3	4,050	3,183	7,233	93.0
26-Jul	2,324	1,792	4,116	96.5	4,112	4,200	8,312	95.5	2,746	3,137	5,883	91.9	4,086	3,278	7,364	94.7
27-Jul	2,354	1,792	4,146	97.2	4,148	4,220	8,368	96.1	2,782	3,194	5,976	93.3	4,172	3,342	7,514	96.6
28-Jul	2,378	1,792	4,170	97.8	4,256	4,250	8,506	97.7	2,908	3,194	6,102	95.3	4,244	3,411	7,655	98.4
29-Jul	2,396	1,812	4,208	98.7	4,376	4,250	8,626	99.1	3,040	3,269	6,309	98.5	4,262	3,453	7,715	99.2
30-Jul	2,408	1,828	4,236	99.3	4,442	4,250	8,692	99.9	3,094	3,269	6,363	99.3	4,268	3,490	7,758	99.7
31-Jul[d]	2,420	1,845	4,265	100.0	4,454	4,250	8,704	100.0	3,136	3,269	6,405	100.0	4,268	3,511	7,779	100.0

-continued-

Appendix D1.-Page 2 of 4.

	1991[a,b]				1992[a,b]				1993[a,b]				1994[c]			
Date	Weir	Harvest	Total	%	Weir	Harvest	Total	%	Weir	Harvest	Total	%	Weir	Harvest	Total	%
20-Jun	6	69	75	1.2	0	7	7	0.1	23	0	23	0.3	24	3	27	0.6
21-Jun	6	91	97	1.5	0	32	32	0.5	47	0	47	0.7	30	3	33	0.7
22-Jun	6	110	116	1.8	6	32	38	0.6	59	23	82	1.2	50	3	53	1.2
23-Jun	18	110	128	2.0	18	32	50	0.8	59	90	149	2.2	56	3	59	1.3
24-Jun	42	110	152	2.4	90	32	122	1.9	86	159	245	3.6	74	3	77	1.7
25-Jun	54	110	164	2.6	216	32	248	3.9	92	250	342	5.1	88	3	91	2.0
26-Jun	84	110	194	3.0	226	32	258	4.0	138	359	497	7.4	88	3	91	2.0
27-Jun	156	128	284	4.5	268	61	329	5.1	156	432	588	8.7	94	3	97	2.1
28-Jun	234	137	371	5.8	308	255	563	8.7	185	547	732	10.8	108	77	185	4.1
29-Jun	272	141	413	6.5	320	383	703	10.9	207	719	926	13.7	140	134	274	6.0
30-Jun	320	143	463	7.3	456	486	942	14.6	231	815	1,046	15.5	147	212	359	7.9
1-Jul	410	157	567	8.9	524	625	1,149	17.9	240	916	1,156	17.1	167	274	441	9.7
2-Jul	554	175	729	11.5	651	724	1,375	21.4	341	916	1,257	18.6	167	338	505	11.1
3-Jul	638	181	819	12.9	691	814	1,505	23.4	462	1,100	1,562	23.1	205	452	657	14.4
4-Jul	752	194	946	14.9	843	973	1,816	28.2	503	1,449	1,952	28.9	318	553	871	19.1
5-Jul	998	201	1,199	18.8	915	1,261	2,176	33.8	550	1,673	2,223	32.9	444	719	1,163	25.5
6-Jul	1,166	231	1,397	21.9	963	1,421	2,384	37.0	634	1,936	2,570	38.0	514	832	1,346	29.5
7-Jul	1,232	257	1,489	23.4	997	1,660	2,657	41.3	724	2,092	2,816	41.7	583	878	1,461	32.0
8-Jul	1,304	1,010	2,314	36.4	1,207	1,871	3,078	47.8	829	2,092	2,921	43.2	752	977	1,729	37.9
9-Jul	1,472	1,183	2,655	41.7	1,277	2,105	3,382	52.5	896	2,092	2,988	44.2	863	1,084	1,947	42.7
10-Jul	1,652	1,243	2,895	45.5	1,385	2,326	3,711	57.7	963	2,331	3,294	48.7	1,025	1,198	2,223	48.7
11-Jul	1,832	1,366	3,198	50.2	1,663	2,476	4,139	64.3	1,114	2,668	3,782	56.0	1,096	1,341	2,437	53.4
12-Jul	1,886	1,413	3,299	51.8	1,819	2,623	4,442	69.0	1,210	2,924	4,134	61.2	1,212	1,419	2,631	57.7
13-Jul	2,054	1,498	3,552	55.8	1,990	2,673	4,663	72.5	1,218	3,390	4,608	68.2	1,315	1,475	2,790	61.2
14-Jul	2,205	1,614	3,819	60.0	2,168	2,673	4,841	75.2	1,224	3,776	5,000	74.0	1,330	1,526	2,856	62.6
15-Jul	2,271	1,749	4,020	63.2	2,514	2,673	5,187	80.6	1,258	3,969	5,227	77.3	1,435	1,556	2,991	65.6
16-Jul	2,415	1,904	4,319	67.9	2,605	2,673	5,278	82.0	1,345	4,173	5,518	81.7	1,703	1,629	3,332	73.1
17-Jul	2,481	1,904	4,385	68.9	2,744	2,673	5,417	84.2	1,374	4,384	5,758	85.2	1,899	1,639	3,538	77.6
18-Jul	2,481	1,904	4,385	68.9	2,876	2,673	5,549	86.2	1,439	4,521	5,960	88.2	2,122	1,639	3,761	82.5
19-Jul	2,649	1,904	4,553	71.5	3,022	2,673	5,695	88.5	1,537	4,746	6,283	93.0	2,204	1,639	3,843	84.3
20-Jul	3,147	1,904	5,051	79.4	3,102	2,673	5,775	89.7	1,646	4,746	6,392	94.6	2,393	1,640	4,033	88.4
21-Jul	3,213	1,904	5,117	80.4	3,202	2,673	5,875	91.3	1,670	4,746	6,416	94.9	2,431	1,640	4,071	89.3
22-Jul	3,609	1,907	5,516	86.7	3,247	2,673	5,920	92.0	1,694	4,746	6,440	95.3	2,485	1,678	4,163	91.3
23-Jul	3,819	1,907	5,726	90.0	3,293	2,673	5,966	92.7	1,746	4,754	6,500	96.2	2,547	1,710	4,257	93.3
24-Jul	4,011	1,907	5,918	93.0	3,375	2,673	6,048	94.0	1,763	4,775	6,538	96.7	2,623	1,710	4,333	95.0
25-Jul	4,167	1,907	6,074	95.4	3,425	2,673	6,098	94.7	1,777	4,801	6,578	97.3	2,663	1,710	4,373	95.9
26-Jul	4,221	1,907	6,128	96.3	3,531	2,673	6,204	96.4	1,779	4,852	6,631	98.1	2,716	1,729	4,445	97.5
27-Jul	4,269	1,907	6,176	97.0	3,556	2,673	6,229	96.8	1,780	4,871	6,651	98.4	2,732	1,746	4,478	98.2
28-Jul	4,311	1,907	6,218	97.7	3,599	2,673	6,272	97.5	1,780	4,911	6,691	99.0	2,753	1,757	4,510	98.9
29-Jul	4,371	1,907	6,278	98.6	3,669	2,673	6,342	98.5	1,789	4,938	6,727	99.5	2,760	1,757	4,517	99.0
30-Jul	4,401	1,907	6,308	99.1	3,720	2,673	6,393	99.3	1,798	4,938	6,736	99.7	2,773	1,757	4,530	99.3
31-Jul[d]	4,455	1,910	6,365	100.0	3,750	2,686	6,436	100.0	1,820	4,938	6,758	100.0	2,788	1,773	4,561	100.0

-continued-

Appendix D1.-Page 3 of 4.

Date	1995[a] Weir	Harvest	Total	%	1996[a] Weir	Harvest	Total	%	10 YEAR AVERAGE % 1985 - 1994
20-Jun	36	23	59	0.8	62	30	92	1.8	0.7
21-Jun	36	23	59	0.8	74	48	122	2.4	0.9
22-Jun	36	23	59	0.8	80	61	141	2.8	1.1
23-Jun	38	23	61	0.8	94	83	177	3.5	1.4
24-Jun	45	56	101	1.3	124	83	207	4.1	1.9
25-Jun	49	60	109	1.5	136	94	230	4.5	2.6
26-Jun	53	60	113	1.5	142	175	317	6.3	3.5
27-Jun	53	102	155	2.1	250	190	440	8.7	4.6
28-Jun	74	133	207	2.8	394	190	584	11.5	6.1
29-Jun	77	133	210	2.8	532	190	722	14.2	8.3
30-Jun	77	133	210	2.8	574	243	817	16.1	9.8
1-Jul	77	133	210	2.8	691	297	988	19.5	11.5
2-Jul	85	133	218	2.9	725	379	1104	21.8	13.4
3-Jul	104	133	237	3.2	798	419	1217	24.0	16.6
4-Jul	140	133	273	3.6	822	447	1269	25.0	20.1
5-Jul	212	133	345	4.6	912	540	1452	28.7	23.7
6-Jul	266	917	1183	15.8	946	632	1578	31.1	27.4
7-Jul	284	1,062	1346	17.9	946	771	1717	33.9	30.6
8-Jul	283	1,475	1758	23.4	964	806	1770	34.9	35.4
9-Jul	503	1,697	2200	29.3	976	876	1852	36.6	40.2
10-Jul	603	1,944	2547	33.9	1,246	974	2220	43.8	46.7
11-Jul	633	2,065	2698	35.9	1,288	1,074	2362	46.6	51.0
12-Jul	982	2,289	3271	43.6	1,402	1,204	2606	51.4	55.2
13-Jul	1,625	2,351	3976	53.0	1,527	1,204	2731	53.9	60.1
14-Jul	2,030	2,351	4381	58.4	1,599	1,204	2803	55.3	63.5
15-Jul	2,358	2,351	4709	62.7	1,709	1,235	2944	58.1	68.0
16-Jul	2,413	2,351	4764	63.5	1,819	1,301	3120	61.6	71.1
17-Jul	2,443	2,469	4912	65.4	2,094	1,337	3431	67.7	74.0
18-Jul	2,587	2,633	5220	69.5	2,270	1,382	3652	72.1	76.9
19-Jul	2,861	2,717	5578	74.3	2,384	1,382	3766	74.3	79.7
20-Jul	2,948	2,773	5721	76.2	2,535	1,382	3917	77.3	82.8
21-Jul	3,104	2,773	5877	78.3	2,577	1,398	3975	78.4	84.8
22-Jul	3,281	2,773	6054	80.6	2,626	1,423	4049	79.9	87.8
23-Jul	3,317	2,916	6233	83.0	2,663	1,474	4137	81.6	89.7
24-Jul	3,360	2,948	6308	84.0	2,740	1,501	4241	83.7	91.2
25-Jul	3,545	2,984	6529	87.0	2,855	1,501	4356	86.0	92.9
26-Jul	3,691	3,008	6699	89.2	2,905	1,501	4406	87.0	94.3
27-Jul	3,775	3,024	6799	90.6	3,030	1,501	4531	89.4	95.4
28-Jul	3,838	3,028	6866	91.5	3,078	1,501	4579	90.4	96.4
29-Jul	3,859	3,028	6887	91.7	3,131	1,501	4632	91.4	97.4
30-Jul	3,895	3,051	6946	92.5	3,163	1,501	4664	92.0	98.0
31-Jul[d]	4,288	3,219	7507	100.0	3,488	1,579	5067	100.0	100.0

-continued-

[a] Percentages are based on weir passage estimates and a 3-day lag time applied to catches made in Chignik Lagoon (statistical area 271-10) to approximate arrival at the weir.

[b] Weir counts for 1987-1993 do not include 1- and 2-ocean chinook salmon, which could not be distinguished from sockeye salmon at the weir. Weir counts for 1982-1992 are based on 10-minute counts made each hour and expanded to include time not counted. In 1993, fish were counted for the first 30 minutes of daily weir operation, and for 10 minutes each hour thereafter.

[c] Starting in 1994, underwater video cameras were used to continuously count fish. One- and 2-ocean chinook salmon were counted and are included in these figures.

[d] This table uses data from a consistent time frame for all years. Counts on 31 July are not always the total count past the weir for the season. The total weir counts (not expanded to include 1- and 2-ocean fish) for chinook salmon each year are as follows:

1987	2,624	1992	3,806
1988	4,868	1993	1,946
1989	3,316	1994	3,016
1990	4,364	1995	4,288
1991	4,545	1996	3,485

10 year average = 3,626.

APPENDIX E. KARLUK RIVER CHINOOK SALMON AGE COMPOSITION, 1995 AND 1996

Appendix E1.-Age, sex, and length composition estimate by age for Karluk River chinook salmon at the weir, 15 May through 20 June 1995.

	Age									
	0.4	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	Total
Females										
Number sampled	0	0	0	2	39	4	0	0	1	46
Percent				1.8	35.5	3.6			0.9	41.8
SE Percent				1.3	4.5	1.8			0.9	4.7
Inriver Return at Weir	0	0	0	127	2,471	253	0	0	63	2,915
SE Return	0	0	0	88	317	124	0	0	63	327
Mean Length				828	823	848			835	825 [a]
SE Mean Length				18	5	11				4
Minimum Length				810	735	820			835	735
Maximum Length				845	888	870			835	930
Males										
Number sampled	0	0	5	15	34	6	0	2	2	64
Percent			4.5	13.6	30.9	5.5		1.8	1.8	58.2
SE Percent			2.0	3.3	4.4	2.2		1.3	1.3	4.7
Inriver Return at Weir	0	0	317	950	2,154	380	0	127	127	4,055
SE Return	0	0	138	227	306	150	0	88	88	327
Mean Length			622	731	817	866		738	813	786 [b]
SE Mean Length			17	12	10	16		3	23	9
Minimum Length			585	630	585	815		735	790	585
Maximum Length			675	811	888	915		740	845	915
All										
Number sampled	0	0	5	17	73	10	0	2	3	110
Percent			4.5	15.5	66.4	9.1		1.8	2.7	100.0
SE Percent			2.0	3.4	4.5	2.7		1.3	1.5	0.0
Inriver Return at Weir	0	0	317	1,077	4,626	634	0	127	190	6,970
SE Return	0	0	138	239	313	190	0	88	108	0
Mean Length			622	742	821	859		738	820	802 [c]
SE Mean Length			17	13	6	11		3	15	5
Minimum Length			585	630	585	815		735	790	585
Maximum Length			675	845	888	915		740	835	930

[a] Includes 13 fish for which age was not estimated.

[b] Includes 17 fish for which age was not estimated.

[c] Includes 30 fish for which age was not estimated.

Appendix E2.-Age, sex, and length composition estimate by age for Karluk River chinook salmon at the weir, 21 June through 26 September 1995.

	Age									
	0.4	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	Total
Females										
Number sampled	0	0	2	5	37	4	0	0	2	50
Percent	0.0	0.0	1.5	3.8	28.0	3.0	0.0	0.0	1.5	37.9
SE Percent			1.1	1.6	3.9	1.5			1.1	4.2
Inriver Return at Weir	0	0	86	215	1,594	172	0	0	86	2,154
SE Return	0	0	60	94	221	84	0	0	60	238
Mean Length			627	798	821	835			832	810 [a]
SE Mean Length			25	12	5	21			10	6
Minimum Length			602	775	780	790			822	602
Maximum Length			652	835	901	890			841	901
Males										
Number sampled	0	9	29	10	28	4	1	0	1	82
Percent	0.0	6.8	22.0	7.6	21.2	3.0	0.8		0.8	62.1
SE Percent		2.2	3.6	2.3	3.5	1.5	0.7		0.7	4.2
Inriver Return at Weir	0	388	1,249	431	1,206	172	43	0	43	3,533
SE Return	0	124	203	130	201	84	43	0	43	238
Mean Length		386	600	722	850	870	637		795	709 [b]
SE Mean Length		11	9	17	8	33				15
Minimum Length		337	480	620	760	805	637		95	337
Maximum Length		435	690	790	921	962	637		795	962
All										
Number sampled	0	9	31	15	65	8	1	0	3	132
Percent		6.8	23.5	11.4	49.2	6.1	0.8		2.3	100.0
SE Percent		2.2	3.7	2.7	4.3	2.1	0.7		1.3	0.0
Inriver Return at Weir	0	388	1,336	646	2,800	345	43	0	129	5,687
SE Return	0	124	208	156	246	117	43	0	73	0
Mean Length		386	602	747	833	853	637		819	747 [c]
SE Mean Length		11	8	15	5	19			13	11
Minimum Length		337	480	620	760	790	637		795	337
Maximum Length		435	690	835	921	962	637		841	962

[a] Includes 8 fish for which age was not estimated.

[b] Includes 18 fish for which age was not estimated.

[c] Includes 26 fish for which age was not estimated.

Appendix E3.-Age, sex, and length composition estimate by age for Karluk River chinook salmon at the weir, 24 May through 20 June 1996.

	Age									
	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	2.5	Total
Females										
Number sampled	0	1	6	25	3	0	0	4	1	40
Percent		1.0	6.1	25.5	3.1			4.1	1.0	40.8
SE Percent		1.0	2.4	4.4	1.7			2.0	1.0	4.9
Inriver Return at Weir	0	57	342	1,423	171	0	0	228	57	2,278
SE Return	0	56	135	245	97	0	0	111	56	276
Mean Length		581	820	827	847			856	911	828 [a]
SE Mean Length			20	8	18			9		6
Minimum Length		581	737	770	812			835	911	581
Maximum Length		581	871	960	875			872	911	960
Males										
Number sampled	0	7	16	21	4	2	7	1	0	58
Percent		7.1	16.3	21.4	4.1	2.0	7.1	1.0		59.2
SE Percent		2.6	3.7	4.1	2.0	1.4	2.6	1.0		4.9
Inriver Return at Weir	0	399	911	1,196	228	114	399	57	0	3,302
SE Return	0	145	208	230	111	79	145	56	0	276
Mean Length		546	732	821	889	593	811	891		741 [b]
SE Mean Length		17	21	14	13	3	12			12
Minimum Length		471	547	652	874	590	769	891		471
Maximum Length		612	828	915	929	595	854	891		929
All										
Number sampled	0	8	22	46	7	2	7	5	1	98
Percent		8.2	22.4	46.9	7.1	2.0	7.1	5.1	1.0	100.0
SE Percent		2.8	4.2	5.0	2.6	1.4	2.6	2.2	1.0	0.0
Inriver Return at Weir	0	456	1,253	2,619	399	114	399	285	57	5,580
SE Return	0	154	234	280	145	79	145	124	56	0
Mean Length		550	756	824	871	593	811	863	911	778 [c]
SE Mean Length		15	18	8	13	3	12	10		8
Minimum Length		471	547	652	812	590	769	835	911	471
Maximum Length		612	871	960	929	595	854	891	911	960

[a] Includes 23 fish for which age was not estimated.

[b] Includes 28 fish for which age was not estimated.

[c] Includes 51 fish for which age was not estimated.

Appendix E4.-Age, sex, and length composition estimate by age for Karluk River chinook salmon at the weir, 21 June through 27 September 1996.

	Age									
	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	2.5	Total
Females										
Number sampled	0	0	2	10	0	0	2	1	0	15
Percent	0.0	0.0	4.4	22.2	0.0	0.0	4.4	2.2	0.0	33.3
SE Percent			3.1	6.2			3.1	2.2		7.1
Inriver Return at Weir	0	0	199	994	0	0	199	99	0	1,490
SE Return	0	0	138	279	0	0	138	99	0	316
Mean Length			814	837			823	742		828 [a]
SE Mean Length			14	11			4			8
Minimum Length			800	781			819	742		742
Maximum Length			828	905			826	742		905
Males										
Number sampled	1	12	7	7	0	1	2	0	0	30
Percent	2.2	26.7	15.6	15.6		2.2	4.4			66.7
SE Percent	2.2	6.6	5.4	5.4		2.2	3.1			7.1
Inriver Return at Weir	99	1,192	695	695	0	99	199	0	0	2,981
SE Return	99	297	243	243	0	99	138	0	0	316
Mean Length	346	553	747	822		636	777			689 [b]
SE Mean Length		21	30	23			1			21
Minimum Length	346	424	654	730		636	776			346
Maximum Length	346	681	866	915		636	778			968
All										
Number sampled	1	12	9	17	0	1	4	1	0	45
Percent	2.2	26.7	20.0	37.8		2.2	8.9	2.2		100.0
SE Percent	2.2	6.6	6.0	7.3		2.2	4.3	2.2		0.0
Inriver Return at Weir	99	1,192	894	1,689	0	99	397	99	0	4,471
SE Return	99	297	268	325	0	99	191	99	0	0
Mean Length	346	553	762	831		636	800	742		731 [c]
SE Mean Length		21	25	11			13			17
Minimum Length	346	424	654	730		636	776	742		346
Maximum Length	346	681	866	915		636	826	742		968

[a] Includes 5 fish for which age was not estimated.

[b] Includes 16 fish for which age was not estimated.

[c] Includes 21 fish for which age was not estimated.

APPENDIX F. AYAKULIK RIVER CHINOOK SALMON AGE COMPOSITION, 1995 AND 1996

Appendix F1.-Age, sex, and length composition estimate by age for Ayakulik River chinook salmon at the weir, 27 May through 20 June 1995.

	Age									
	0.4	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	Total
Females										
Number sampled	1	0	0	5	29	1	0	0	1	37
Percent	1.0			5.0	29.0	1.0			1.0	37.0
SE Percent	1.0			2.2	4.5	1.0			1.0	4.8
Inriver Return at Weir	97	0	0	485	2,813	97	0	0	97	3,589
SE Return	97	0	0	211	440	97	0	0	97	468
Mean Length	839			774	836	806			823	826 [a]
SE Mean Length				29	7					5
Minimum Length	839			686	753	806			823	686
Maximum Length	839			865	929	806			823	929
Males										
Number sampled	0	2	7	9	39	5	0	0	1	63
Percent		2.0	7.0	9.0	39.0	5.0			1.0	63.0
SE Percent		1.4	2.6	2.9	4.9	2.2			1.0	4.8
Inriver Return at Weir	0	194	679	873	3,783	485	0	0	97	6,112
SE Return	0	136	247	278	473	211	0	0	97	468
Mean Length		328	557	718	856	904			731	782 [b]
SE Mean Length		3	14	26	8	11				16
Minimum Length		325	517	539	765	881			731	325
Maximum Length		330	607	771	972	935			731	972
All										
Number sampled	1	2	7	14	68	6	0	0	2	100
Percent	1.0	2.0	7.0	14.0	68.0	6.0			2.0	100.0
SE Percent	1.0	1.4	2.6	3.5	4.7	2.4			1.4	0.0
Inriver Return at Weir	97	194	679	1,358	6,597	582	0	0	194	9,701
SE Return	97	136	247	337	452	230	0	0	136	0
Mean Length	839	328	557	738	847	888			777	800 [c]
SE Mean Length		3	14	20	6	19			46	9
Minimum Length	839	325	517	539	753	806			731	325
Maximum Length	839	330	607	865	972	935			823	972

[a] Includes 26 fish for which age was not estimated.

[b] Includes 25 fish for which age was not estimated.

[c] Includes 51 fish for which age was not estimated.

Appendix F2.-Age, sex, and length composition estimate by age for Ayakulik River chinook salmon at the weir, 21 June through 28 August 1995.

	Age									
	0.4	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	Total
Females										
Number sampled	0	0	2	1	34	4	0	0	0	41
Percent			1.8	0.9	30.6	3.6				36.9
SE Percent			1.3	0.9	4.4	1.8				4.6
Inriver Return at Weir	0	0	144	72	2,450	288	0	0	0	2,955
SE Return	0	0	101	72	349	141	0	0	0	366
Mean Length			591	840	837	880				829 [a]
SE Mean Length			34		5	24				9
Minimum Length			557	840	783	845				557
Maximum Length			624	840	939	951				951
Males										
Number sampled	0	10	23	10	22	3	1	0	1	70
Percent		9.0	20.7	9.0	19.8	2.7	0.9		0.9	63.1
SE Percent		2.7	3.8	2.7	3.8	1.5	0.9		0.9	4.6
Inriver Return at Weir	0	721	1,658	721	1,586	216	72	0	72	5,045
SE Return	0	217	307	217	302	123	72	0	72	366
Mean Length		378	591	786	844	979	569		831	695 [b]
SE Mean Length		17	10	20	12	44				19
Minimum Length		291	507	661	719	901	569		831	291
Maximum Length		473	695	898	960	1,055	569		831	1,055
All										
Number sampled	0	10	25	11	56	7	1	0	1	111
Percent		9.0	22.5	9.9	50.5	6.3	0.9		0.9	100.0
SE Percent		2.7	4.0	2.8	4.7	2.3	0.9		0.9	0.0
Inriver Return at Weir	0	721	1,802	793	4,036	505	72	0	72	8,000
SE Return	0	217	316	226	379	184	72	0	72	0
Mean Length		378	591	790	840	923	569		831	743 [c]
SE Mean Length		17	10	19	6	29				14
Minimum Length		291	507	661	719	845	569		831	291
Maximum Length		473	695	898	960	1,055	569		831	1,055

[a] Includes 10 fish for which age was not estimated.

[b] Includes 20 fish for which age was not estimated.

[c] Includes 30 fish for which age was not estimated.

Appendix F3.-Age, sex, and length composition estimate by age for Ayakulik River chinook salmon at the weir, 24 May through 20 June 1996.

	Age									
	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	2.5	Total
Females										
Number sampled	0	2	9	23	2	0	3	0	0	39
Percent		2.3	10.5	26.7	2.3		3.5			45.3
SE Percent		1.6	3.3	4.8	1.6		2.0			5.4
Inriver Return at Weir	0	149	673	1,719	149	0	224	0	0	2,915
SE Return	0	104	212	307	104	0	127	0	0	345
Mean Length		602	762	827	852		774			803 [a]
SE Mean Length		1	12	10	28		11			7
Minimum Length		601	721	715	824		761			601
Maximum Length		602	825	929	880		796			930
Males										
Number sampled	4	16	9	15	1	0	2	0	0	47
Percent	4.7	18.6	10.5	17.4	1.2		2.3			54.7
SE Percent	2.3	4.2	3.3	4.1	1.2		1.6			5.4
Inriver Return at Weir	299	1,196	673	1,121	75	0	149	0	0	3,513
SE Return	146	269	212	263	74	0	104	0	0	345
Mean Length	343	573	745	826	934		772			698 [b]
SE Mean Length	13	13	18	14			33			17
Minimum Length	320	455	696	748	934		739			292
Maximum Length	381	673	869	958	934		805			969
All										
Number sampled	4	18	18	38	3	0	5	0	0	86
Percent	4.7	20.9	20.9	44.2	3.5		5.8			100.0
SE Percent	2.3	4.4	4.4	5.4	2.0		2.5			0.0
Inriver Return at Weir	299	1,345	1,345	2,840	224	0	374	0	0	6,428
SE Return	146	282	282	344	127	0	162	0	0	0
Mean Length	343	576	754	826	879		773			745 [c]
SE Mean Length	13	12	11	8	32		12			11
Minimum Length	320	455	696	715	824		739			292
Maximum Length	381	673	869	958	934		805			969

[a] Includes 28 fish for which age was not estimated.

[b] Includes 36 fish for which age was not estimated.

[c] Includes 64 fish for which age was not estimated.

Appendix F4.-Age, sex, and length composition estimate by age for Ayakulik River chinook salmon at the weir, 21 June through 25 August 1996.

	Age									
	1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	2.5	Total
Females										
Number sampled	0	1	7	14	3	0	0	0	0	25
Percent		1.0	6.7	13.3	2.9					23.8
SE Percent		0.9	2.4	3.3	1.6					4.1
Inriver Return at Weir	0	37	261	522	112	0	0	0	0	932
SE Return	0	37	94	129	63	0	0	0	0	161
Mean Length		807	787	841	888					826 [a]
SE Mean Length			10	12	16					9
Minimum Length		807	736	777	856					719
Maximum Length		807	817	945	905					994
Males										
Number sampled	3	32	23	17	2	0	3	0	0	80
Percent	2.9	30.5	21.9	16.2	1.9		2.9			76.2
SE Percent	1.6	4.5	4.0	3.6	1.3		1.6			4.1
Inriver Return at Weir	112	1,193	858	634	75	0	112	0	0	2,984
SE Return	63	174	157	140	52	0	63	0	0	161
Mean Length	335	572	725	864	903		908			682 [b]
SE Mean Length	10	9	15	13	20		32			15
Minimum Length	317	459	519	771	883		845			317
Maximum Length	353	696	850	954	922		942			954
All										
Number sampled	3	33	30	31	5	0	3	0	0	105
Percent	2.9	31.4	28.6	29.5	4.8		2.9			100.0
SE Percent	1.6	4.5	4.4	4.4	2.1		1.6			0.0
Inriver Return at Weir	112	1,231	1,119	1,156	186	0	112	0	0	3,916
SE Return	63	176	171	173	81	0	63	0	0	0
Mean Length	335	579	740	853	894		908			723 [c]
SE Mean Length	10	11	13	9	11		32			13
Minimum Length	317	459	519	771	856		845			317
Maximum Length	353	807	850	954	922		942			994

[a] Includes 18 fish for which age was not estimated.

[b] Includes 27 fish for which age was not estimated.

[c] Includes 45 fish for which age was not estimated.

APPENDIX G. CENSUS OF SOCKEYE SALMON, STEELHEAD/RAINBOW TROUT, AND DOLLY VARDEN HARVESTED AND RELEASED BY ANGLERS PASSING THE WEIRS AT THE KARLUK RIVER, 1993-1996, AND AYAKULIK RIVER, 1995 AND 1996

Appendix G1.-Sport harvest and release of sockeye salmon, steelhead/rainbow trout, and Dolly Varden from the Karluk River, 1993-1996.

	Sockeye Salmon		Steelhead/Rainbow Trout		Dolly Varden	
Location	Harvest	Release	Harvest	Release	Harvest	Release
1993						
Spit	68	51	0	3	2	0
Lagoon	218	83	0	25	0	7
Weir	51	326	7	113	28	1,201
Total	337	460	7	141	30	1,208
1994						
Weir	111	601	5	199	7	458
Portage	16	86	0	64	44	393
Total	127	687	5	263	51	851
1995						
Weir	140	784	5	221	21	399
1996						
Weir	125	718	3	120	44	262

Source: Schwarz (1996) for 1993 and 1994 data. Years 1993 and 1994 were censuses of the entire river. Years 1995 and 1996 (this study) were censuses of anglers passing the weir.

Appendix G2.-Census of sockeye salmon, steelhead/rainbow trout, and Dolly Varden harvested and released by anglers passing the Ayakulik River weir, 1995 and 1996.

	Sockeye Salmon		Steelhead/Rainbow Trout		Dolly Varden	
Year	Harvest	Release	Harvest	Release	Harvest	Release
1995	228	476	0	222	0	87
1996	329	245	0	126	0	119